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MAILING THE ELECTRICAL WORLD.

The present number of The Electrical World will be mailed folded once lengthwise, thus leaving, when opened, a crease in the page. Should we learn from our readers that this is found objectionable, we will endeavor to mail the paper in such form as to obviate any cause of complaint.

THE DIGEST FOR 1893.

Some idea of the field which has been covered by our weekly Digest may be had from the fact that during the past eleven months, since it was started, there were published in this department over 2,000 abstracts and references, which required the careful reading of over 800 issues of journals, of which about two-thirds were in foreign languages. If this were a mere index of the titles of articles, such figures would mean very little, but by far the larger part of the Digest is formed of abstracts containing what are believed to be the most important parts of a paper or article, or whenever an article does not admit of being abstracted we endeavor to give an idea of its general nature in order that readers may know before looking up the original whether it would be likely to be of interest to them, a feature in which this department differs greatly from a mere index. Furthermore, whenever an original article in a foriegn language which we have abstracted is subsequently translated and published in an English journal, we always call attention to the translation for the benefit of those who are not conversant with the foreign language, but would like to read the original.

THE TELEPHONE PATENTS.

As pointed out by Mr. W. A. Rosenbaum in another column, the patent on the metallic diaphragm telephone will expire on Jan. 30, after which date it will be possible to use the telephone for commercial purposes on shorter lines, and even to operate an exchange system in competition with the monopoly which has so long reaped a magnificent harvest. Had the ordinary course been followed in the Patent Office in relation to the Berliner patent, the principle of telephony by means of variable contact resistance would also soon be public property, and until this patent expires or is annulled, the Bell monopoly cannot be very seriously affected. If by proper means this patent was retained in the Patent Office for fourteen years, by this process practically prolonging the life of an absolute monopoly to that extent, a monstrous state of affairs is admitted which, if it cannot be otherwise remedied, would almost justify the entire abolition of the patent system. It is true that the government has now a suit to annul this patent for reasons stated in the article, but a recent statement as to its condition does not give much encouragement for a speedy decision, and it has already cost the government $80,000. With the wide knowledge of the subject which the Attorney General should have from his former connection with the telephone interests, it would seem that more haste might be made, particularly as, if the suit is finally successful, every day after Jan. 30 will result in a gross injustice to the public through the continuance of the monopoly. Mr. Rosenbaum refers to a fact that may be very significant, which is that the Blake application of Jan. 3, 1880, has not yet, as far as can be ascertained, resulted in a patent. After what has occurred regarding the Berliner patent, we may expect anything from the Patent Office, and it would not be a matter of any great surprise if the Blake, or some other telephone patent now held, were

Changes in the General Electric Company.

The General Electric Company has announced that it has been definitely decided at a meeting of the Executive Committee of the Board of Directors to make the Schenectady works the main factory of the company, while the Lynn plant will be conducted as an annex for the manufacture of such small standard articles as are required in large numbers. The New York office and salesroom are to be taken to Schenectady, which will be made the general headquarters of the company. New buildings have recently been completed, and, as fast as required, the force will be increased, and the works, it is stated, soon again run on full time. The lamp works will remain at Harrison, N. J., and the Eastern District headquarters at 44 Broad street, New York, where offices will also be retained by the directors and general officers.

Thoughts on Cosmical Electricity.

BY PROF. ELIHU THOMSON.

Prof. Thomson prefaced his remarks by stating that he had attempted to apply known principles to conditions of the heavenly bodies and that he thought there was much to learn in this field.

Beginning with the consideration that as we rise from the earth's surface to different altitudes there appears to be a gradual increase of potential with respect to the ground, such that at a thousand feet, as at the top of the Eiffel tower, there may be 10,000 volts difference between the air at the top and the surface, he assumed that this difference might increase as we reach high altitudes, and that at 20 or 30 miles the potential difference might amount to a million volts more or less. This would seem to indicate the possession of a positive charge by the higher layers of the atmosphere. He stated, however, that it had not yet been proven that a pure gas could carry a charge of electricity and instanced the case of a drop of water suspended in the air and charged to a certain potential. If the air were dry and the drop evaporated the potential would rise gradually until when it was entirely evaporated the potential would be infinite. This consideration would be based on the fact, if it be a fact, that liquids in evaporating do not part with their electricity. The increased potential of the drop, however, might have other effects, such as the repulsion of its particles and its division into an extremely comminuted state.

After stating the nature of the electrical charge as dependent upon capacity and potential he showed that whenever the capacity is diminished the potential, with a given amount of electricity, rises and vice versa, but went on to state that attraction and repulsion, and other phenomena could be explained by the general tendency of all bodies to increased capacity. He adduced considerations going to show that there was a relative repulsion between charges of electricity besides the attraction between opposite charges, and that, therefore, the lines of electrostatic stress would agree with those of magnetism in their tendency to shorten and also to spread laterally.

He then took up the question as to whether a perfect vacuum is or is not a conductor of electricity, and brought forward the results of recent investigations as showing that an excellent vacuum is not a conductor, but, on the other hand, is the most perfect insulator. Taking this in connection with the fact that dense air is a good insulator, that rarefied gas is a fair conductor, and that the solid body of the earth is a conductor, he compared the earth to a huge condenser possessing a positive charge in the outer layers, while the earth itself might be less positive or negative. Using the results of Prof. Rowland's works on the movement of a charged body giving rise to magnetism and principle of an air condenser, he put forward the idea that the earth being a huge rotating condenser with the positive charge in the upper layers of the atmosphere and the negative charge at the ground, it would necessarily follow that magnetism could be developed in the region between this upper layer and the earth by the rotation of these charges.

He then traced the actual direction of the magnetism which would be produced, finding that the direction was the proper one to accord with facts, and that the compass needle indicates the direction. He mentioned that the idea had come to him that possibly thunder storms were in a measure due to flaws in the dense air as a dielectric, and explained in detail, somewhat, his thoughts on this subject. He drew attention to the consequences which would follow the possession by a mass of nebulous gas of a charge of electricity; this, if insulated in space, would, as its volume diminished by the radiation of heat and condensation, gradually increase in potential however small the charge originally possessed. The sun might, therefore, be a charged body having a relatively high potential, which potential would undergo elevation on further condensation. He put forward, as a thought on this subject, that a possible explanation of the solar periods as due to electrical states; the sun reaching a certain potential by the repulsion of small electrified particles loses that potential by the passing of the coronal stream, and not only a part of the charge which it possessed, but also a considerable amount of the charged material which might be encountered by the earth in its movement around the sun, and so give rise to an auroral display.

He concluded the lecture by stating that it was possible, in his opinion, that temporary stars, that is, stars becoming visible and then fading away, might therefore be explained on an electrical hypothesis, viz., that charged bodies possessing a difference of electrical potential when they approach near enough might exchange electricity between themselves on the grandest scale, giving rise to a uniformity of charge on their leaving each other; that this would naturally be done in a vast display, which would only last for a moment of time.

*Abstract of a lecture delivered before Franklin Institute, Dec., 1893.

Moonlight Tables for January, 1894.

Herewith we give Mr. H. W. Frund's tables of lighting hours for the month of January under his modified form of moonlight schedule.

TABLE NO. 1.
Standard Moonlight.
Philadelphia System.

Date.	Light.	Date.	Exting.
1	5.10 P. M.	2	5.30 A. M.
2	5.10 "	3	5.30 "
3	5.10 "	4	6.30 "
4	5.20 "	5	6.30 "
5	5.20 "	6	6.30 "
6	5.20 "	7	6.30 "
7	5.20 "	8	6.30 "
8	5.20 "	9	6.30 "
9	5.20 "	10	6.30 "
10	5.20 "	11	6.30 "
11	8.30 "	12	6.30 "
12	9.30 "	13	6.30 "
13	10.40 "	14	6.30 "
14	11.40 "	15	6.30 "
15			
16	12.50 A. M.	16	6.20 A. M.
17	2.10 "	17	6.20 "
18	3.20 "	18	6.20 "
19	4.40 "	19	6.20 "
20	No Light.	20	No Light.
21	"	21	
22	5.40 P. M.	22	7.30 P. M.
23	5.40 "	23	8.30 "
24	5.40 "	24	10.00 "
25	5.40 "	25	11.10 "
26	5.40 "	27	12.00 A. M.
27	5.40 "	28	1.20 "
28	5.40 "	29	2.20 "
29	5.40 "	30	3.30 "
30	5.40 "	31	4.30 "
31	5.50 "	1	5.30 "

TABLE NO. 2.
Frund's New Moonlight
System.

Date.	Light.	Date.	Exting.
1	5.10 P. M.	2	4.30 A.M.
2	5.10 "	3	5.30 "
3	5.10 "	4	6.30 "
4	5.20 "	5	6.30 "
5	5.20 "	6	6.30 "
6	5.20 "	7	6.30 "
7	5.20 "	8	6.30 "
8	5.20 "	9	6.30 "
9	5.20 "	10	6.30 "
10	5.20 "	11	6.30 "
11	5.20 "	12	6.30 "
12	5.20 "	13	6.30 "
13	5.20 "	14	6.30 "
14	5.20 "	15	6.30 "
15	5.20 "	15	12 M.
16	12.30 P. M.	16	6.20 A. M.
16	5.30 "	16	12 M.
17	2.10 A. M.	17	6.20 A. M.
17	5.30 P. M.	17	12 M.
18	5.30 "	18	12 "
19	5.30 "	19	12 "
20	5.30 "	20	12 "
21	5.30 "	21	12 "
22	5.40 "	22	12 "
23	5.40 "	23	12 "
24	5.40 "	24	12 "
25	5.40 "	25	12 "
26	5.40 "	27	12.10 A. M.
27	5.40 "	28	1.20 "
28	5.40 "	29	2.20 "
29	5.40 "	30	3.30 "
30	5.40 "	31	4.30 "
31	5.50 "	1	5.30 "

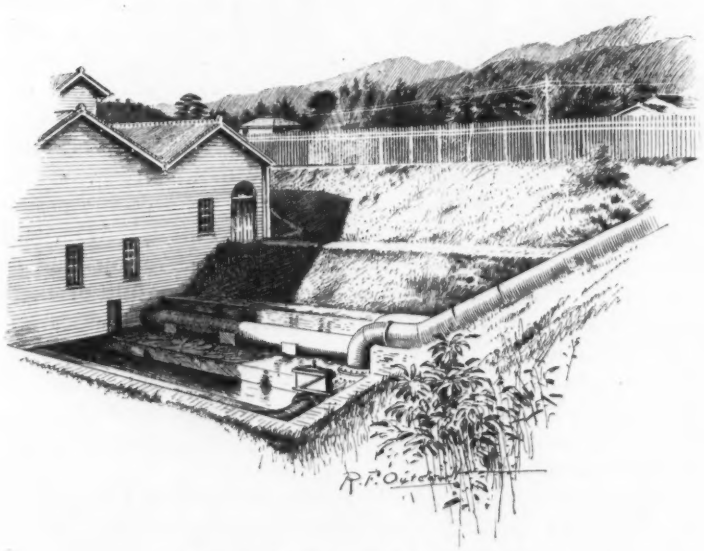
Electricity in the Far East.

BY W. STUART-SMITH.

THE willingness of the Japanese to adopt, without reserve, a civilization totally different in character from that under which they had previously lived is one of their most striking characteristics. While they are very conservative in many ways, they are the most liberal people in the world in others. Twice in their history they have experienced a complete change of front, and adopted a foreign civilization. The first time was many centuries ago when Chinese civilization, with its literature, manufactures and science, was found to be better than their own, and its adoption raised them from a state of barbarism to one of comparatively high civilization; and now, in these last few decades, the new civilization of the West has been adopted to a degree that must astonish any one who has a thorough understanding of the magnitude of the change that has taken place. To a traveler spending but a few days in the country, and in that time going into some part immediately outside of the treaty ports, it may seem that the civilization is still that of the Far East, and that it has but little in common with the West, but to one who has had the good fortune to spend a few years in the country, the extent of the movement is apparent.

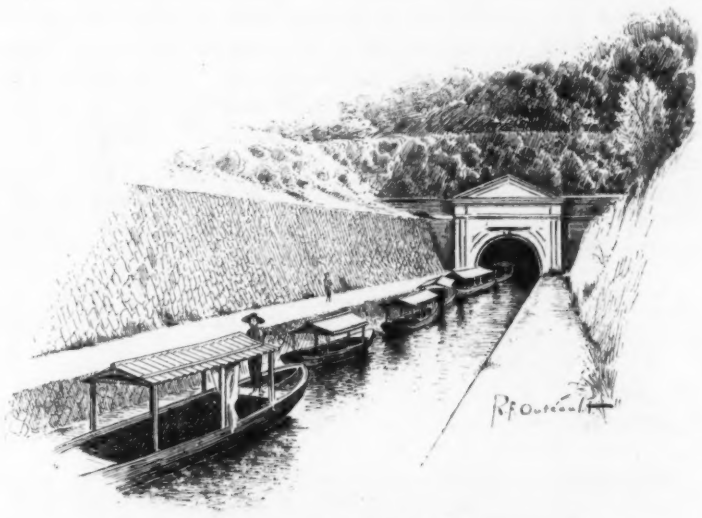
In no way is this change made more evident than in the hold which electricity has taken in the past five years.

The telegraph, of course, has been in use since soon after the opening of the country and now extends to all parts of



LAKE BIWA POWER HOUSE.

the Empire. When it was first established there were many amusing occurrences, due to the inability of the people to understand how the message was sent over the wire. The writer's first visit to Japan was early in 1886, and one day he was, with a guide, walking over a remote mountain road along which passed a telegraph line. A countryman was met who had seated himself by the roadside and was intently watching the wire. His gaze was so fixed that the guide asked what he was doing, and he replied that he was waiting to see a message go along the wire, that he had watched many times since it was put up, but had never been able to see anything. The road on which this incident occurred is that leading from Utsonomiya to Nikko. At Nikko, about 400 years ago, Iyeyasu, the first shogun of the Tokugawa family, was hard pressed by his enemies, who had beaten him in battle. A mountain stream much swollen by heavy rains barred his further progress and he was in danger of being captured, when an angel appeared and assisted him and his followers across the stream. His enemies could not cross and he escaped, and soon after utterly crushed them. As a remembrance of the divine assistance given him, he determined to build the most magnificent temples in Japan upon the site of his escape, and the result of this decision was the world-renowned Nikko temples. At the place where he was as-



ENTRANCE TO NAGARAYAMA TUNNEL.

sisted across the stream a sacred bridge was built over which only the Emperor is allowed to pass, and the high priest once a year. The daimios contributed money lavishly for the temples, and when they were finished one daimio who had plenty of land and men but little money, said he had not been able to contribute toward building the temples, but would send men to build a road by which they could be reached. The result was the road twenty miles long, between Utsunomiya and Nikko. Before the march of modern progress broke in upon it it was a far finer monument than the temples themselves. These trees shown used to extend the whole distance, except where broken here and there by a village, but now the railroad has been built to Nikko and cuts the road in many places, destroying its beauty. One of the earliest telegraph lines, extending into the interior, was built along this road.

This incident was, perhaps, no more amusing than the reception of the telephone in Rio Janeiro. The writer was in that city when the exchange was being started and considerable opposition was shown, as the people supposed nothing but English could be spoken and in order to be able to use it they must learn that language.

The telephone is not in general use, but there are some good exchanges, the best being in Yokohama and Tokio. These two cities are conected by telephone, the distance being about twenty miles. All telegraph and telephone lines are owned by the government, and so far this fact has interfered with the building of electric railways, permission having been refused for any roads with rail return.

Electric lighting is exceedingly popular and several cities are supplied from central stations and there are many private plants in mills and factories.

Of all the electrical plants in Japan, by far the most interesting is the power plant of the Kyoto Canal Company, or,

as it is called, the Sui-Ri-Jiniusho. This was built by the government for the purpose of giving a new lease of life to a dying city.

For six or seven hundred years Kyoto was the residence of the Mikado or Emperor, and the name is made up of words signifying the "place of residence of the king." In the present capital, Tokyo, the same words are used and the significance is the same. From a small town Kyoto grew to be a city of perhaps 400,000 people, but when the great revolution which overthrew the power of the Tycoon or Shogun was ended and the Mikado restored to his proper power, it was thought advisable to move the capital to Yedo (Tokyo) and continue the seat of government where it had been in fact for more than three hundred years. The effect was at once seen in the decrease of the population of Kyoto. When the Japanese began to manufacture on a considerable scale it was seen that Kyoto might be kept from falling into decay if it could be converted into a manufacturing city. Lake Biwa is about six miles from the suburbs of the city and is separated from it by a range of hills called Nagarayama and a smaller range called Hino-oka-Yama. Through the city runs the waterway, Kamogawa, allowing boats to pass from Kyoto to tidewater in Osaka Bay. Lake Biwa is about 150 feet above the Kamogawa in Kyoto, and as this lake is by far the largest in Japan, being about 500 square miles area

WHAT WE MIGHT EXPECT.

and having a large contiguous agricultural territory, it has long been desired to connect it with the Kamogawa, the first record of such a proposition being dated in the twelfth century.

Lake Biwa is so named because it has the shape of a "biwa" or Japanese harp. About 300 miles from it is the highest mountain in Japan, the peerless Fujiama, 13,000 feet high and the most sacred mountain in Japan, where all volcanoes are worshiped as being the homes of dragons. Tradition has it that about the beginning of the Christian era this mountain was thrown up from the level plain in one night, and that at the same time the ground subsided over a vast extent of territory and that the depression thus formed filled with water and became Lake Biwa.

About 1882 or 1883 Mr. S. Tanabe, then a student in the Engineering College of the Imperial University, took as the subject of his graduating thesis the construction of a canal from Lake Biwa to Kyoto. He proposed that the canal should have sufficient depth and width to float the boats found on Lake Biwa and fall enough to carry sufficient water for power purposes in the suburbs of Kyoto, to furnish water by a branch canal for irrigation, and to supply the city with water under a good pressure for fire and sanitary purposes. The matter was ably presented and at an opportune time, as it was necessary that something be done for the relief of Kyoto. The result was that the project was taken into serious consideration by the "powers that be," and it was finally decided to carry out the work as outlined by Mr. Tanabe, and as he had presented the matter in such an able manner he was appointed engineer-in-chief of the undertaking, a very responsible position for a young man just graduated. The work was carried out so successfully that Mr. Tanabe now stands in the first rank of Japanese engineers. He is at present professor of engineering in the Imperial University.

It has been stated in articles relating to this plant that Mr. Tanabe had lost his right hand and was obliged to make all plans, etc., with his left. This is happily an error, as he has only lost one finger of his right hand, though at the time he made the plans he was suffering with rheumatism and his right hand was out of commission, so he did make the drawings with his left.

The estimated cost was 1,250,000 yen, but, as usual, this estimate was exceeded, and 1,600,000 yen was expended. Of this about one-third was an imperial gift, one-fourth was a grant from the central government, and the remainder was raised by taxes of one kind or another on the city of Kyoto; these taxes were largely in the form of trade and land taxes. The work was done under the auspices of the city government, and during the construction the city assembly and governor fixed the amount to be spent for the coming year, basing their estimates on the expenditures of the past year.

Work was begun in March, 1885, and the canal was completed in April, 1890. The entire length is 6 7-8 miles, divided into two sections—the longest being 5 1-4 miles, and extending from Lake Biwa through the hills to the suburbs, and the other, 1 5-8 miles long, extending from the suburbs into the centre of the city. Between these two sections is a fall of 120 feet. The first intention was to overcome this by means of locks, but the plan was changed and an inclined plane railroad built having a total length of 1,800 feet and a grade of 1 in 15. A cable is used with a cradle car at each end and the first intention was to drive it by power obtained from a waterwheel placed at the foot.

At the time the canal was projected, electric power had not taken a prominent place, and the idea was to have mills and factories located about the foot of the incline and obtain power by means of wheels run by water piped from the canal above. Provision was made for about 2,000 h. p. on the wheels. Before the canal was completed, however, electric power transmission came strongly to the front, and in 1888 Mr. S. Tanabe and Mr. B. Takagi, one of the assistant engineers, came to America to study the question, and after considerable time spent in making observations and in consultation they returned to Japan. The result of their report was a determination to abandon the idea of locating mills, etc., around the incline. The flexibility of electric transmission, in virtue of which power can easily be sent to mills and factories located in remote parts of the city, made it possible to more fully carry out the purpose for which the work was undertaken.

Where the canal begins the lake is shallow, and the intake was formed by reclamations extending about 1,000 feet into the lake. Still water is insured by a breakwater, the material for this lake work being debris from the tunnels, etc.

The first stretch of open canal extends from the lakeside about 600 yards to the Nagarayama range and is in section 28, 19 feet wide and 5 feet deep. At the lake side a regulating lock and sluice gate are provided, by which the flow is kept constant at 300 cubic feet per second.

The first tunnel through the Nagarayama range, a view of the entrance to which is given herewith, is the longest in Japan, 2,680 yards. It is horseshoe in section, 16 feet wide by 14 feet high, with a depth of water of 6 feet. It is cut through slate, hornstone, sandstone and quartz-

porphyry and is lined throughout with masonry and brick-work. From this first tunnel there is an open stretch of canal 4,837 yards long, partly in cutting but mostly along the hillsides, with an outer built-up bank in many places. From the end of this stretch, tunnels Nos. 2 and 3, 137 yards and 934 yards respectively, lead the canal through the Hino-oka-yama range to the incline and site of the power-house for running the cable.

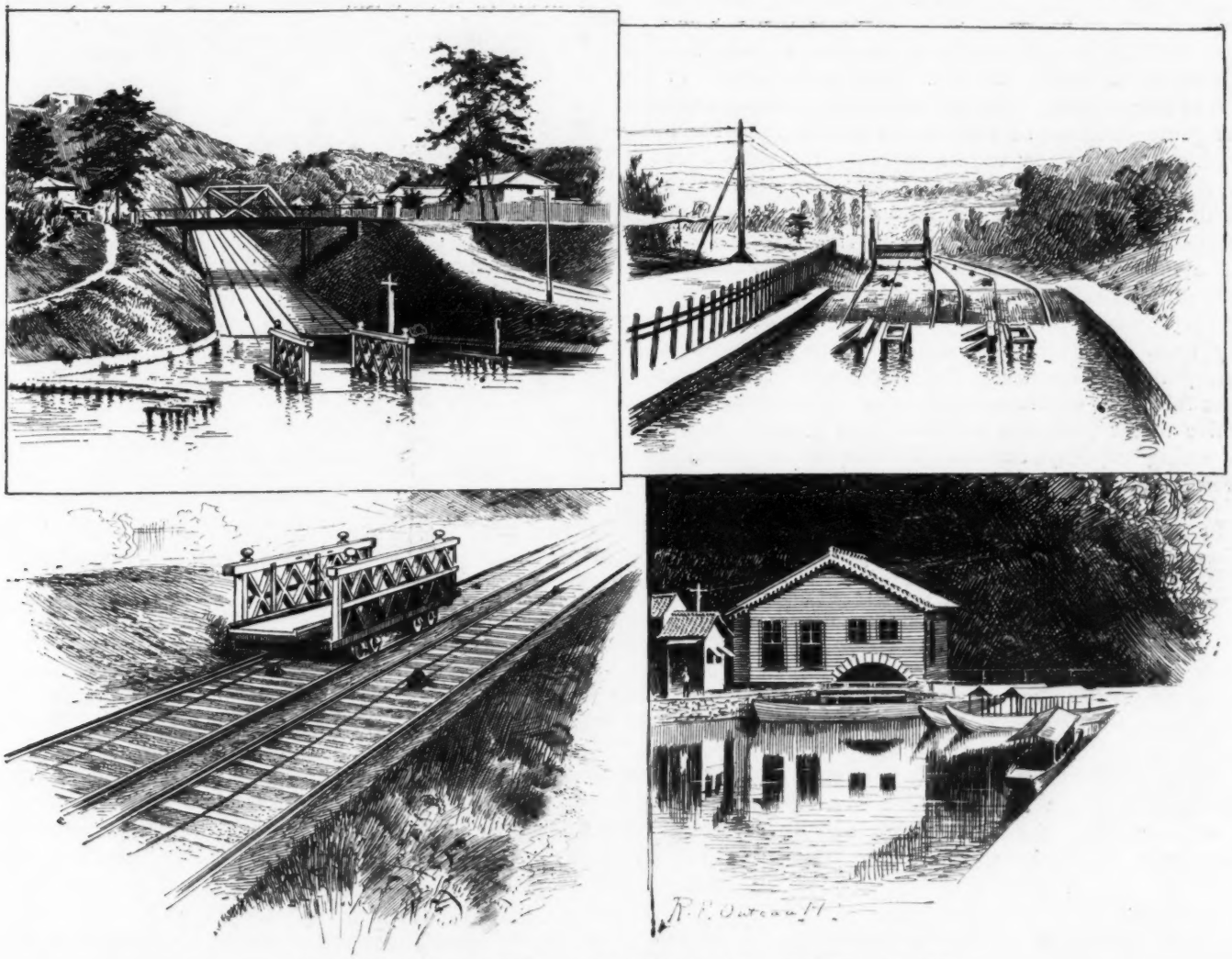
At this point the canal branches, and one-sixth of the total water supply is carried northward through a small canal, a total distance of 5 1-4 miles. This part is of no interest from an electrical point of view, as the water is used solely for irrigating purposes. It winds along the hillsides, and in one place crosses the valley of the Imperial Tombs in an aqueduct of fourteen arches. This branch takes 50 cubic feet per second, leaving 250 cubic feet for power purposes.

Boats are hauled up and down the incline, being loaded on to the cradle cars at the ends of the cable. At the top of the main incline is a short reverse one of the same grade, 1 in 15, down which the car descends into the water until a boat can be floated on, while at the bottom the main incline leads far enough into the lower canal to float the boat off.

It was first proposed to locate a reversible Pelton wheel at the bottom of the incline to drive the cable drum, but when the change to electricity as a motive power was decided upon the power house was located at the head of the incline, and it is now run by a 50-h. p. Sprague automatic motor. When first started, the motor ran the same way all the time, and the drum was fitted with a reversing clutch and gear, but later carbon brushes and a reversing switch were fitted to the motor as being easier to handle.

As it was not convenient to locate the power house at the very foot of the incline, and thus be able to utilize the entire fall, the ground was leveled about 400 feet from the foot and a deep pit was dug in which the power house is built. By this means the tail race was brought nearly to the lower canal level.

When fully completed the station is designed to hold twenty 8-foot Pelton wheels, each giving 120 h. p. under an effective head of 100 feet, after allowing for loss of head by friction, etc., but at present the station building occupies but little more than one-half the pit, the intention being to extend it as occasion demands. Two pipes, each 36 inches diameter, lead the water to the wheels from the canal above, these being sufficient to furnish power for all the wheels that



LAKE BIWA INCLINED RAILWAY AND POWER HOUSE.

can be placed in the present building. When the station is complete there will be four such pipes. From the canal to the pit one pipe is cast iron of English make, 1,307 feet in length; the other is wrought iron of Japanese manufacture, 1,511 feet in length. The remaining two will be of Japanese make. In the pit and the building both pipes are of wrought iron.

A view given shows the unoccupied portion of the pit with the tail race and main pipes, and one end of the incline and the power house for working the cable. The one above it depicts the head of the incline, showing the reverse incline and the car about to descend into the water to receive a boat. The view to the left of this shows the bottom of the main incline, while the one below it gives a view of the cradle car employed.

(To be continued.)

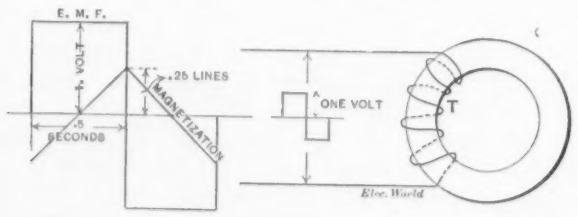
Alternate Current Working.

BY HARRIS J. RYAN.

DURING the past ten years there have been extensive developments in the use of the electric current for the transmission of energy for lighting and power purposes. One of the fundamental requirements for success in the wide extension of these uses of the electric current consists in the use of limited amounts of copper in the conductors. To meet this requirement it has been necessary to adopt methods that enable electric currents to be used that are transmitted at high pressures. Energy developed in the form of the alternating current is best suited for transmission over great distances because of the simplicity of the transforming apparatus, by means of which the proportions of current and pressure are arranged at any position in the working system to suit the requirements of transmission and utilization.

The fundamental phenomena of practical importance in alternate current working result from the electromotive forces produced in closed circuits in which the currents vary from instant to instant. Alternating currents cause corresponding alternating magnetizations that, in turn, cause the above electromotive forces. We also have electromotive forces produced by alternating currents in circuits possessing capacity through electrostatic processes. The pressure between the terminals of a condenser is proportional to the quantity of electricity stored in such condenser at any instant. An alternating current set up through a condenser gives rise to rates of change of the condenser charge that are proportional to the amounts of current at different instants, thus producing alternating differences of pressure, or electromotive forces. All alternate current actions are produced and regulated intelligently through a thorough understanding of the quantitative nature of these two classes of phenomena. Attention will be given to them, as they are the elements of alternate current working.

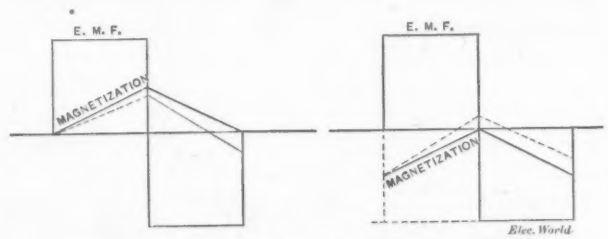
We will first study the quantitative nature of the alternating magnetizations that are necessary for the production of typical forms of alternating electromotive forces. The first of this series of electromotive forces is given in Fig. 1.



FIGS. 1 AND 2.

This is the form that is obtained in a circuit by the periodic reversal of the direction of some source of constant E. M. F. The figure illustrates the case in which these reversals of an E. M. F. of one volt occur every half second. For every second we have an application of the E. M. F. in each of two possible directions, or the production of a complete cycle or period of variation of E. M. F. This cycle of variation ends as it began, by making a change of the E. M. F. in the upward or positive direction, as indicated in the diagram. In Fig. 2 the laminated iron ring is wound with a number of turns T. This coil T is subjected to an alternating E. M. F. of the form represented in Fig. 1. The conductor from which the turns on the ring are formed is comparatively large, so that the current that will produce any desired degree of magnetization in the iron ring will cause a the fall of potential in the coil equals the impressed E. M. F. ble. Under these circumstances current will be set up through the winding in such amounts at any given instant as to cause a magnetization of the ring that produces an E. M. F. counter to the actuating or impressed E. M. F. At all instants the sum of the counter E. M. F. developed and the fall of potential in the coil equals the impressed E. M. F. just as is the case in the operation of a direct current motor. The fall of potential produced by the current is small, consequently the counter E. M. F. is practically equal to that of the impressed E. M. F. at all instants. To produce this E. M. F., then, it is necessary that the rate of change of the amount of magnetism set up in the ring at each instant shall numerically be equal to the number of C. G. S. volts of E. M. F. to be developed in each turn of wire.

There are 108 units in the practical volt, hence the rate for any instant divided by this number gives the E. M. F. produced per turn in ordinary measure. In this case an E. M. F. is to be developed per turn equal in form to that illustrated in Fig. 1. One C. G. S. volt exists for one-half second in one direction, and during that time we must have the magnetization in the iron ring changing at the rate of one line per second. Since the E. M. F. to be developed is constant throughout the time of one-half second it is necessary that this rate of change of one line of magnetism per second



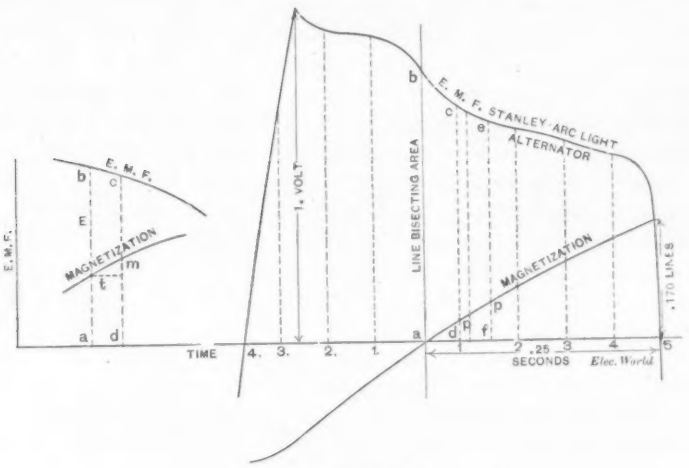
FIGS. 3 AND 4.

must also be constant throughout that time. For any particular half second this rate of change may be accomplished, as illustrated in Fig. 1, by cutting out and cutting in uniformly one-fourth line of magnetism from a negative to a positive direction. This would give a constant change of magnetism at the rate of one line per second for one-half second. Again the same rate of change during one-half second would have been accomplished by increasing the magnetism in a positive direction from zero to one-half a line uniformly throughout one-half second as indicated by Fig. 3. The same result would have ensued by diminishing the magnetization of one-half line from a negative direction as indicated in Fig. 4. For the first case, Fig. 1, the magnetism would be alternating; second case, Fig. 3, pulsating in a positive direction, and in the third case, Fig. 4, pulsating in the negative direction. The last two conditions are never even partially realized for more than a very few alternations. This is due to the fact that the resistance of no electric circuit can be made to disappear. In Fig. 3 the full line represents the change of magnetization when the fall of potential is neglected and the counter E. M. F. is, therefore, equal and opposite at all instants to the impressed E. M. F. Actually this is never completely realized. To maintain magnetization as indicated in Fig. 3 the current, and therefore the fall of potential in the primary, will be positive at all times. Then when the impressed E. M. F. is positive the counter E. M. F. will be less by an amount equal to the fall of potential caused by the current. During this time the rate of change of magnetism will be less, and is indicated by the dotted line. When the impressed E. M. F. is negative the counter E. M.

F. must be greater by the amount of the fall of potential caused by the current. During this time the rate of change of the magnetism must be greater than that indicated by the full line, and the broken line is extended to represent the further actual path of the magnetization. It is evident that the magnetic variation is rapidly changed from a pulsating to an alternating form. A similar consideration for Fig. 4 shows the same tendency, but from an opposite direction. It may then be stated positively that no matter at what point on the E. M. F. curve the circuit is closed the magnetic variation rapidly loses all pulsating characteristics and becomes alternating after the first few cycles.

It should be noted here that the alternating magnetization passes through zero at the instant when the area of the generated wave of E. M. F. is bisected. This is due to the following facts:

The positive and negative maximum values of magnetiza-



FIGS. 5 AND 6.

tion must be equal. The area developed in the E. M. F. card between any particular instants is numerically equal to the change of magnetism that took place during the interval. This is more clearly understood by reference to Fig. 5. t is a small interval of time during which the rate of change of magnetism may be considered to go on at a uniform rate, and the E. M. F., E, therefore, remains constant. During this interval the magnetization has increased by an amount m, as indicated in the diagram. $m \div t$ is the rate of increase of the magnetization, and is numerically equal to the E. M. F.

$$m \div t = E \qquad m = t\,E$$

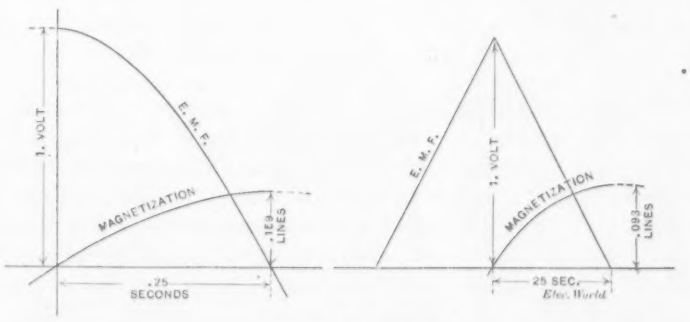
Consequently, this increment of magnetization is equal to the product of the E. M. F. it produces into the time during which the increment took place. This product is the area of the parallelogram $a\ b\ c\ d$, or the area developed by the curve of E. M. F. during the time t. It follows then that the entire area of the E. M. F. diagram from any given interval of time is equal to the sum of all the increments of magnetization that occurred to produce the E. M. F. that existed during that time. The sum of these increments is equal to the total increase of magnetization that occurred during a given interval. What is true of the increments is true of the decrements of magnetization.

One-half of the area of the E. M. F. diagram for one alternation must, therefore, be produced by the magnetization coming to zero from its maximum value in one direction, and the other half by the increase of the magnetization to its maximum value in the other direction. What has just been said is illustrated in Fig. 6. In this figure the curve of E. M. F. is taken from a Westinghouse arc light alternator at work on a circuit of 40 arc lamps. The figure is a study of the variation of magnetism necessary to produce the E. M. F. as given. The line $a\ b$, bisecting the area of the E. M. F. diagram was located by means of an ordinary planimeter. Then from the point a, at which the zero of magnetization occurs, the curve of magnetization was extended by the location of points $p\ p'$, etc. For example, the point p was located by reading by means of the planimeter the area $a\ b\ c\ d$. This quantity, we have seen, is numerically equal to the value of the magnetization at p, and is, therefore, properly located in the diagram, after the selection of a suitable vertical scale. The magnetization at the point p' is equal to the area $a\ b\ e\ f$, etc. In this way the complete curve on each side of the zero was determined by the location of a number of points that enabled the curve to be drawn. It is to be observed that although the time occupied by an alternation is one-half second, and the maximum E. M. F. one C. G. S. volt, or the same as in Fig. 1, yet the magnetization needs to attain a maximum of but .170 line in Fig. 6, while it attains a value of .25 line in Fig. 1. This is due, of course, to the fact that in Fig. 6 the E. M. F. is less than one volt throughout the alternation, except for one instant only. The ratio between the maximum E. M. F. in an alternation of a given form per turn of conductor to the maximum of the magnetization needed to produce this form of E. M. F., is a constant of the utmost importance. This ratio for the form of E. M. F. curve in Fig. 1 is $1 \div .25 = 4$, and for that in Fig. 6 is $1 \div .170 = 5.88$. The following numerical work was done in the study of Fig. 6:

The curve of E. M. F. was plotted on Carpenter's cross-section paper. On this paper one large division has a length of one inch. Maximum height of E. M. F. card, 3.6 inches, equals 1 volt.

	Sq. In.
Total area of card by planimeter	10.7
Area at first point to right of bisecting line	1.35
Area at second point to right of bisecting line	2.48
Area at third point to right of bisecting line	3.58
Area at fourth point to right of bisecting line	4.57
Area at fifth point do. one-half total area	5.35
Area at first point to left of bisecting line	1.59
Area at second point to left of bisecting line	3.16
Area at third point to left of bisecting line	4.78
Area at fourth point do. one-half total area	5.35
	Inch.
Length of card, equals one-half second	4.4
Length of complete cycle equals one second	8.8

A change of magnetization in a circuit at the uniform rate of one line per second will develop one C. G. S. volt per turn of conductor. With the scale adopted in the figure



FIGS. 7 AND 8.

the area developed per second by a constant E. M. F. of one volt is

$$3.6 \times 8.8 = 31.6 \text{ sq. in.}$$

By dividing each of the areas determined above by 31.6 we obtain the following magnetizations:

RIGHT OF BISECTING LINE.

Magnetization at Point 1	.042 line.
Magnetization at Point 2	.078 line.
Magnetization at Point 3	.114 line.
Magnetization at Point 4	.145 line.
Magnetization at Point 5	.170 line.

LEFT OF BISECTING LINE.

Magnetization at Point 1	.050 line.
Magnetization at Point 2	.100 line.
Magnetization at Point 3	.152 line.
Magnetization at Point 4	.170 line.

These values were used in plotting the magnetization curve given in Fig. 6.

Fig. 7 is a study of a sine form of E. M. F. curve to which a great amount of practice conforms approximately. The curve of magnetization was determined by means of a planimeter in precisely the same manner as in Fig. 6. Upon examination we find it to be a sine curve also; and of the same form as the E. M. F. curve that it produces. This is an especially valuable property, as will be seen through a study of the performances of alternate current motors. For this form the ratio of the maximum E. M. F. to the maximum magnetization is,

$$1 \div 159 = 6.28 = 2\pi.$$

Fig. 8 gives a study of the last of these typical forms of E. M. F. curves. The magnetization was determined as in the preceding cases. The ratio of maximum E. M. F. to maximum magnetization is,

$$1 \div .093 = 10.7$$

A glance at the various ratios just determined will be profitable. It takes approximately two and one-half times the magnetization in Fig. 8 to produce the E. M. F. in Fig. 1. Between the limits of variation found in practice this ratio of the extremes of requisite magnetizations may vary as much as 2. As the curve of E. M. F. is flattened the curve of magnetization is pointed; and as the former is pointed the latter is flattened. With the sine form common ground is met.

(To be continued.)

The Telephone Situation.

BY WILLIAM A. ROSENBAUM.

THE expiration of the fundamental telephone patent in March of last year created considerable commotion in telephone circles, although possibly the upheaval was more among the general public than in the American Bell Telephone Company. At any rate the event brought forth a large number of inquiries from financially interested parties and exhaustive and numerous articles in the various journals touching upon the future status of makers and users of telephones as against the Bell Company, which has so effectually held its monopoly during the past seventeen years.

It has been impossible until recently to make a definite statement of the condition of the various controlling patents because of the absence of a final construction of the statutes by the Supreme Court regarding the effect of the expiration of a foreign patent upon the life of a United States patent applied for or issued subsequent to the issue of the foreign patent. Even now the condition of the Berliner patent and the basic Blake patent can only be surmised, but the circumstances bearing upon these two are such that their fate can be foretold with a reasonable degree of certainty. I believe that a brief statement setting forth the nature and scope of the fundamental patents and their present status would be of interest and value at the opening of the new year, which bids fair to be a lively one in telephone circles, and I have endeavored, in what follows, to present the matter clearly and concisely.

The patents which are generally recognized as controlling the telephone situation are the following:

1, The original Bell, dated March 7, 1876; 2, the Bell receiver, dated Jan. 30, 1877; 3, the Blake transmitter, dated Nov. 29, 1881; 4, the Hunning transmitter, dated Aug. 30, 1881; 5, the Berliner transmitter, dated Nov. 17, 1891; 6, the Edison transmitter, dated May 3, 1892.

When it is certain that all of these patents have expired by regular limitation, or otherwise become void, the field of commercial telephony is practically open to the public. That is to say, barring these patents, a serviceable transmitter and receiver may be made, sold and used. The following is a statement of the condition of each of the above patents: (1) The original Bell patent, which is the fundamental patent covering all practical methods of transmitting articulate speech by electricity, expired by statutory limitation on March 7, 1893, it having then been in force its full term of seventeen years. (2) The Bell receiver patent, which covers, in the broadest possible manner, an electro-magnet in combination with a plate (diaphragm) of iron or steel, or other material capable of inductive action, which can be thrown into vibration by the movement of the surrounding air or by magnetic attraction, will expire by statutory limitation on January 30, 1894, it having then been in force its full term of seventeen years. (3) The Blake transmitter patents are four in number, and they were issued Nov. 29, 1881. The first covers a diaphragm held against a ring seat by a spring pressing at its free end against the centre of one side of the diaphragm. The second covers an unimportant detail of construction. The third covers an arrangement of springs to hold the electrode in contact, regardless of the movements of the diaphragm, and the fourth is for a special arrangement of weight for doing the same thing. The British patent on these inventions issued January 20, 1879, prior to the dates of filing of the applications of all the above Blake patents in this country. Ordinarily, under that condition, the latter would expire with the British patent, which took place January 20, 1893. (4) The Hunning transmitter patent, which covers broadly the use of granular carbon in a loose state, as the variable resistance, would not expire regularly until Aug. 30, 1898, but fortunately for the public the same invention was patented in England in September, 1878, long before the application in this country was filed, and the United States patent therefore expired with the English on September 16, 1892. (5) The claims of the Berliner patent are broadly for the method of producing in a circuit electrical undulations, similar in form to sound waves, for the purpose of varying the pressure between electrodes in constant contact and thereby varying the resistance of the circuit. In other words, this patent covers the well known and commonly used means (a pair of electrodes in contact) for carrying out the fundamental method disclosed in the original Bell patent of 1876. The application for the Berliner patent was filed June 4, 1877, and did not become a patent until Nov. 17, 1891. On its face, therefore, this patent is a practical continuation for another seventeen years from November, 1891, of the monopoly which the Bell company has already so long enjoyed. (6) The Edison transmitter patents are three in number, and they were all issued May 3, 1892. The application for one of them was filed in April, 1877, and for the other two in July of the same year. The first is unimportant, as it covers a resistance medium consisting of a disc-like piece of plumbago in contact with the diaphragm. The other two are important, one covering a diaphragm with one or more carbon points (electrodes) in contact with it, and the other an electrode or point mounted on a spring. All three of these patents are, however, void because they were issued after the death of a foreign patent for the same invention. (Huber vs. Nelson Manufacturing Co., Supreme Court decision of March 27, 1893.)

As to the condition of the Blake patents it may be remarked that the applications upon which they are based were divisions from other applications, all disclosing the

same inventions, and the earliest of which was filed January 3, 1879, prior to the date of the British patent. It is therefore maintained by the Bell company that this early application renders Section 4,887 inoperative against the later patents and they are therefore still in force. A circuit court in the case of the Gramme Electrical Company vs. Arnoux and Hochhausen Electrical Company, held that the meaning of Section 4,887 "is that the United States patent shall expire at the same time with the foreign patent which was granted before the United States patent was granted, and not that it shall expire at the same time with the foreign patent which was granted before the application for the United State patent was made." Also, in the case of the Bate Refrigerator Company vs. Gillett, Judge Nixon said that he was "at a loss to understand what the time of filing the application has to do with the matter." This position of the Bell company would therefore appear to be untenable, and I am of the opinion that it would be safe to assume that the Blake patents are void. It is interesting to note a matter which apparently has heretofore been overlooked, to wit, the fact that the Blake application of Jan. 3, 1879, has not yet resulted in a patent. What has become of it, and is it to be a second Berliner surprise?

It seems highly improbable that the Bell company will be able to sustain the Berliner patent. A suit has been brought by the Attorney General to annul it, and the grounds set forth seem to be sufficient to accomplish that end. One is the long delay in issuing the patent, which, it is alleged, was purposely done by the company to secure an extension of its monopoly. Another is that the specifications and drawings were materially and improperly altered after the application was filed. It is also urged that a patent, issued to Berliner in 1880, covered the same apparatus, and further that Edison and not Berliner was the real inventor. The Patent Office is also charged with irregularities and errors on the part of its employes in connection with the matter. On the whole, a pretty strong case is made out against the patent, and the result will be looked for with much interest and with the reasonable expectation of its annulment.

In conclusion, it is quite safe to assert that after January 30, 1894, commercial telephony will be open to the public. It is to be understood, however, that this refers to the use of the "instruments" only, and that there are many patents under the control of the Bell company on the details of the central office apparatus which have several years to run. The fundamental principle of the switchboard, however, is open, and it would be an aspersion upon our inventors to suggest that they cannot produce a commercial switching system which will not infringe the existing patents.

Faure Accumulator Patent in Germany.

It is understood that the Imperial Court of Appeals at Leipsic has just decided that the employment of lead in the state of super-oxide, oxide, or insoluble salts as a filling material for accumulator plates comes under Faure's patent.

Dielectric Hysteresis.

Signor Riccardo Arno, through Professor Galileo Ferraris, recently communicated a paper to the Accademia Dei Lincei, of Rome, giving the result of quantitative researches on the dissipation of energy in dielectric bodies in a rotary magnetic field. Experiments were performed on numerous materials in the form of cylinders, such as glass, guttapercha, paraffine, mica, caoutchouc, etc., and in each case it was found that the dissipation of energy varied nearly as the induction raised to the 1.6 power. The departure from this value in any case was small, but greatest for paraffine.

The Theory of Hysteresis.

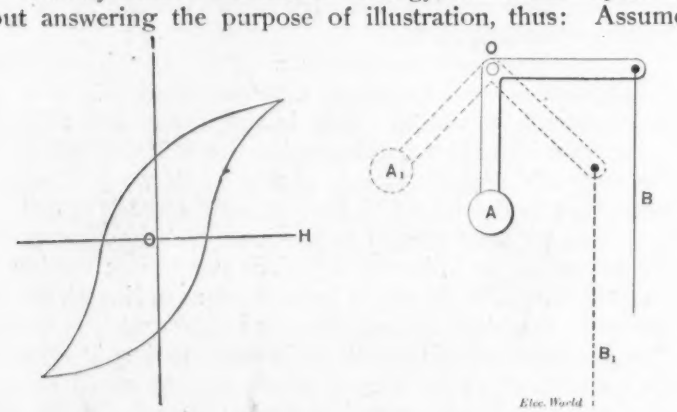
BY TOWNSEND WOLCOTT.

AS some of the fundamental ideas in the theory of hysteresis are very commonly misunderstood, the writer wishes to offering the following explanations and illustrations, even at the risk of saying some things which are already so well known as to be of little interest. The word hysteresis, introduced by Ewing in 1881, from the Greek ὑστερέω, to lag behind, was a new name for a newly discovered fact. Neither the name nor the fact received the attention they deserved for some years after. The lag to which the name hysteresis applies is the lag of phase of the magnetism of iron or other magnetic material, behind the magnetizing force applied thereto. That is to say, if we apply a magnetizing force to a given sample of iron, and measure the resulting magnetism in the iron, we find that the latter is not always the same for the same magnetizing force, but depends also upon the preceding condition of the system, that is, whether the given value of the magnetizing force is reached by increasing or diminishing its previous value. The value of the magnetism in the second case is greater than in the former. Or, to make the case more specific, take an electromagnet and send a current through its helix, gradually increasing the strength of the current from zero up to a given value, say one ampere. Then measure by any known means the total magnetism of the iron core. Now gradually increase the current again considerably above one ampere to a maximum, and then gradually decrease it again to one ampere. Again measure the magnetism of the iron, and it will be found to be greater than before. This *phase* lag is hysteresis proper, and is entirely independent of any *time* lag, that is, any tendency of the magnetism to grow or shrink with the lapse of time under a constant magnetizing force.

There is another phenomenon, which, although connected with hysteresis, and frequently confounded with it, is by no means identical with it. This is the absorption of other forms of energy, and the conversion thereof into heat, when the magnetism of the iron is changed. If we plot to any suitable scale the values of the magnetic force $\mathfrak{H}$ (produced by a helix or other means) as abscissae, and the corresponding values of the induction $\mathfrak{B}$ (lines per square centimetre produced in the iron) or the intensity $\mathfrak{I}$ as ordinates, we obtain for a complete cycle of changes in the magnetic force a closed loop more or less like the accompanying illustration, Fig. 1, according to the specimen experimented on. It was shown by Warburg, and by Ewing himself, that the area of this loop represented work done by the magnetic force, and they both concluded that this work was in every case that which was dissipated in heat, and consequently if we could get rid of the hysteresis we would also be rid of the heat. Mr. Steinmetz, however, in his classical paper read before the American Institute of Electrical Engineers on Sept. 27, 1892, takes another view of the matter. The heat loss, he says, is due to molecular friction, and for a given specimen, between given limits of induction, the loss per cycle and per cubic centimetre is a constant quantity, and cannot be altered except by some such process as hardening or annealing, which alters the whole nature of the specimen. If the energy necessary to overcome the molecular friction is furnished by the magnetic force, then it hinders the magnetizing process and causes hysteresis. If, therefore, we could get rid of the molecular friction we would also get rid

of hysteresis and heat. On the other hand, if we supply the energy necessary to overcome the molecular friction by outside means, such as mechanical vibrations, the hysteresis disappears, but the heat remains. The area of the hysteresis loop does indeed represent energy, and the exact amount of energy furnished by the magnetic force during one cycle. Also as the energy furnished to a magnet in charging is given off again in discharging, this work for a complete cycle is zero, therefore the area of the hysteresis loop represents work done by the magnetic force outside of the magnetizing process proper. This work, however, may be equal to or greater or less than the heat dissipated by molecular friction. If it so happens that the magnetic force has to overcome the molecular friction and no other waste, then the area of the loop is what Warburg and Ewing thought it to be. If, however, there is other work to do, such as the production of eddy currents, the area will be greater than the energy dissipated by molecular friction, but as in this case the energy of the eddy currents eventually becomes heat, the area still represents the total dissipated heat. If, as before remarked, the energy necessary to overcome the molecular friction be supplied by mechanical vibrations, the loop may be entirely collapsed or even inverted so that the hysteresis becomes negative, and the magnetic force is assisted instead of being hindered. Or, to put the matter in the fewest words, Ewing says that there is dissipation of energy in heat because of hysteresis; Steinmetz says there is hysteresis because the energy of the magnetic circuit is dissipated. The immediate practical application of this is that we cannot improve the efficiency of our apparatus by "shaking out" the hysteresis, but only by improving the quality of our iron. The demonstration of Prof. Chas. A. Perkins in the last issue of The Electrical World (even if it be accepted as an unexceptionable demonstration, which I am afraid it will not be generally), only proves that the area of the loop equals the work done by the magnetic force per cycle, and not the energy absorbed by the iron, except as before stated when the two happen to be equal.

We may make a mechanical analogy, somewhat imperfect, but answering the purpose of illustration, thus: Assume



FIGS. 1 AND 2.

a lever bent at right angles, as in Fig. 2, pivoted at O, with a weight at A, a cord at B, in perfect balance when the weight hangs vertically below O Now the pull on the cord B where there is no friction on the pivot O is proportional to the tangent of the angle of deflection of from the vertical, so that it would take an infinite pull on the cord B to raise A to the horizontal. The vertical position of $O\,A$ corresponds to demagnetization of the iron, the horizontal to magnetic saturation, and the pull on to the magnetizing force. This case corresponds to iron free from molecular friction. The induction in the iron (position of OA) is related to the magnetizing force (pull on B) by a simple law, and it makes no difference in this relation whether the pull on B is increasing and A rising, or the pull decreasing and falling. If now friction be introduced at the pivot O, we find this simple law modified.

Starting from the vertical position of OA if we pull on B with a given force, say ten pounds, A takes a certain position; now if we pull B still harder and raise A still higher and then slack off on B until the strain is ten pounds again, the deflection of OA will be greater than before, and the deflection of OA for a pull of ten pounds when there is no friction is between these two.

This represents hysteresis, phase lag (observe there is no time lag). So long as there is no way of overcoming the pivotal friction but by the extra pulling on the cord in rising and extra slacking in falling (to allow the weight to overcome it) the phase lag must remain, and a diagram of this phase lag, plotted with the pull on B as abscissae and the vertical motion of B as ordinates, we would have a closed loop as in the well known magnetic hysteresis curve, and, moreover, the area of the loop would be proportional to the work done in overcoming the friction. This loop might be collapsed by rapping on the pivot O, but to make the analogy perfect this ought to consume as much energy as before. Another common idea is that the molecular friction loss is less in slow running machines than in fast running machines of the same output, or at all events, this loss combined with the loss from eddy currents is less in the slow running machines.

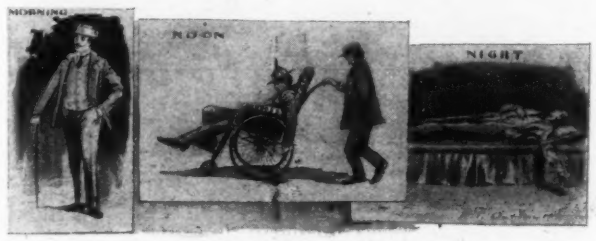
The density of induction in different parts of an armature is not by any means the same and so the molecular friction loss is not the same in each cubic centimetre of the iron. However, the ratio of the densities of any two parts is constant for different densities (that is, if the density be doubled in one part, it will be also doubled in the other parts), and if the loss in the whole armature for a given density in one part be known, then if the density of this part be changed in a given ratio, the loss in the whole armature will still follow Steinmetz's law of the 1.6 power of the ratio. The eddy current loss varies with the second power of the E. M. F. which produces it, and this E. M. F. depends upon the total induction cut per second. Given a dynamo, determinate speed, E. M. F., etc., if we reduce the speed we reduce the E. M. F. in the same ratio.

To restore the E. M. F. there are three courses open: First, to increase the density of induction, and therefore the total amount in the same ratio as the speed is decreased; second, to increase the cross section of the iron and therefore the total induction with the same density; and, third, to increase the armature windings, leaving the total induction the same. In the first case, the molecular friction loss per cycle will be increased in the 1.6 power of the ratio in which the density is increased, and the number of cycle diminish in the same ratio as the speed. The eddy current loss will be unaltered. In the second case, the molecular friction loss is the same as in the high speed machine, for the cubic centimetres of iron are increased in the same ratio as the cycles are diminished. If the extra cross section is given by adding more discs, the eddy current E. M. F. in each disc varies directly as the speed, and the loss in each disc varies directly as the second power of the speed, but as there are more discs the total loss varies directly as the speed. There is, therefore, some saving in the eddy currents here. If the iron be increased by using the same number of discs of larger diameter or of smaller internal diameter, in the case of rings, the resistance of the eddy current circuit is diminished so that the loss is the same as in the high speed machine. In the third case both losses are reduced, the molecular friction loss in the same ratio as the speed, and the eddy current loss in the second power of that ratio.

I think it is a fact that the only class of slow speed machines showing a remarkably small percentage of these losses are those which, like slow speed car motors, have a much greater length of wire per volt than good high speed dynamos or motors.

SOME EVENTS OF THE PAST YEAR 1893 A BACKWARD GLANCE AT 1893

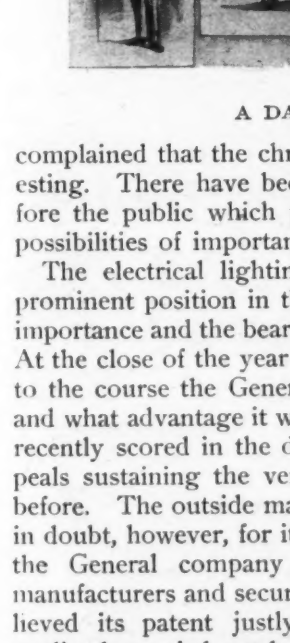
Looking backward over the year which has just been brought to a close and mentally collecting its scattered records, one is readily led to the conclusion that at least it has not been an uneventful one. It is true that the electrical world has not been startled with the disclosure of inventions of great practical and commercial importance, such as the telephone or incandescent lamp, but the electrical calendar has undergone such rapid and varied changes that it cannot be



A DAY AT THE FAIR.

complained that the chronicle of events for 1893 is uninteresting. There have been, too, some discoveries placed before the public which possess much scientific interest and possibilities of important practical developments.

The electrical lighting industry has occupied the most prominent position in the field, both on account of its own importance and the bearing which it has on kindred interests. At the close of the year 1892 the public was still in doubt as to the course the General Electric Company would pursue, and what advantage it would take of the signal victory it had recently scored in the decision of the Circuit Court of Appeals sustaining the verdict of Judge Wallace of the year before. The outside manufacturers were not to remain long in doubt, however, for it was soon evident that the policy of the General company was to close up the infringing manufacturers and secure to itself the monopoly which it believed its patent justly conferred. This policy was immediately carried out by securing restraining orders against several companies, but the first case to create much attention was that of the Beacon Vacuum Pump and Electrical Company, which came to trial at Boston on Jan. 23. The Goebel defense was then introduced for the first time and created a profound sensation in electrical circles. Nothing daunted by the adverse decision of Judge Colt in this case, the Columbia Incandescent Lamp Company renewed the fight at St. Louis, and this time it proved successful in so far that a restraining order was refused. A similar defense was brought forward in the Oconto case at Milwaukee, but in the preliminary hearing the decision was in favor of the Edison interests, while the opinion in the final hearing has not yet been handed down. Meanwhile, most of the other lamp manufacturers had been restrained, until the General Company was left almost alone in the field. At the close of 1892 the Westinghouse Electric and Manufacturing Company had announced its intention of placing upon the market with the opening of the new year a new non-infringing stopper lamp, and early in January this lamp made its appearance. The series of important lamp suits was closed by the argument of the case of the Edison Electric Light Company et al. vs. Waring Electric Company et al. at Hartford early in December. This time the fight was along different lines, the "Novak" interests acknowledging the validity of the Edison patent and claiming non-infringement on the ground that their lamp contained an atmosphere of gas in place of the Edison vacuum. The court has as yet reached no decision in this case and lamp manufacturers and others are still looking forward to the result. While the difficulty of obtaining lamps other than those of the Edison make has resulted in considerable embarrassment, it has still been possible to secure such lamps, and the absolute monopoly of the Edison



FAIR TICKETS FOR TWO.

CELEBRITIES AT THE CONGRESS.

interest has been broken. With the prospect of the early expiration of the Edison patent it is probable that the situation during the coming year will be much more encouraging.

The Electrical World has throughout the year devoted the attention to this important question which it merited. It was the first journal, electrical or otherwise, to bring into prominence the celebrated Goebel defense, and the only one that presented anything like complete reports of the cases. To Boston, St. Louis, Milwaukee and Hartford The Electrical World sent special representatives, and to all save one its own special artist, with the result that it was enabled

in all these cases to present an exhaustive and elaborate report. From time to time in these columns the incandescent lamp situation has been fully discussed, and the opinions of men prominently identified with these interests published.

AND STILL THEY COME!

The telephone question has been second only to that of electric lighting and has been brought to public attention by the expiration of the Bell patents and the possibility that the monopoly so long held by the Bell Company might at last pass from its hands. The Bell fundamental patent expired March 7 and in less than a month hence—Jan. 30, 1894—the patent on the metal diaphragm will have reached the end of its life. The Edison carbon transmitter patents are admittedly void, and there is little doubt that after January 30 the Bell Company must rest its claim for a monopoly entirely upon the Berliner patents, whose validity is now being tested in the courts. Several telephones have been placed on the market during the year, but either because of suits brought by the Bell Company, or for other reasons, they have not as yet entered into active competition. The situation promises to be even more interesting during the coming year, and it is possible that the great question may finally reach a settlement.

The long distance telephone line between New York and Chicago has been extended at the one end to Boston and at the other to Milwaukee, and many other cities between these points have been given the benefit of long distance transmission of speech. Various improvements in long distance apparatus have been made and steady progress in the direction of the details essential to the success of this work. One of the sensations of the year was the paper by Prof. Silvanus P. Thompson on "Ocean Telephony" at the International Congress of Electricians.

The Electrical World has covered this question with its characteristic thoroughness and presented at frequent intervals articles discussing the situation from every point of view. No better illustration can be given of the clear and able way in which the subject has been handled than by reference to an article on the subject which appears elsewhere in this issue.

ELECTRICITY.

Telegraphy is too old an art to expect rapid advance each year. Steady progress has been made, however, in the improvement of old forms of apparatus and the use of new, and this is especially the case in the adoption of dynamos and accumulators to replace primary batteries for telegraphic work. The increase in speed of ocean telegraphy is another line along which progress is gradually being made. Prof. Gray's telautograph may be said to be the sensation of the year in this field and on its exhibition in New York, and later at the World's Fair, was received with great interest. By far the most elaborate and scientific discussion of this apparatus appeared in the columns of The Electrical World.

The electric railway has continued to maintain its position as the most extensive of the practical applications of electricity during the past year. In many of our cities horse cars have now become objects of curiosity. Brooklyn has perhaps shown the greatest advance and has now replaced almost all its horse lines by electric cars. Baltimore has also gone into the construction of electric railways extensively during the past year, as have many important cities in the West. The Intramural railway at the World's Fair marked an important step in electric traction. This was the first practical application of electricity to the propulsion of railway trains and was an unqualified success, and its influence will undoubtedly be felt in the near future. The Chicago and St. Louis electric railroad has, unfortunately, not materialized, but its promoters still express hope of its final completion. The electric railway has recently scored another important victory in the defeat of its rival, the cable, in New York City, as the Metropolitan Traction Company has just offered a prize of $50,000 for a satisfactory system to replace that which it has recently installed at an enormous expense. Accumulator traction continues to give promise

WESTERN ELECTRIC COMPANY AT THE WORLD'S FAIR
IN ELECTRICITY BUILDING
THROUGH ELECTRICITY BUILDING
THE INTRAMURAL RAILWAY AT THE WORLD'S FAIR
WESTINGHOUSE ELECTRIC & MANUFACTURING

WORLD'S FAIR REMINISCENCES.

of more rapid development in the future, and during the past year one of the important lines in New York City has been partially equipped with accumulator cars, which have now been successfully running for some months. Accumulators have also extended their field of application in other directions, and the Edison illuminating companies of New York and Boston have important large storage battery plants as auxiliaries to their stations, and American manufacturers have given indications of their intention in the future to manufacture batteries of much larger capacity, thus following the example set by their foreign competitors.

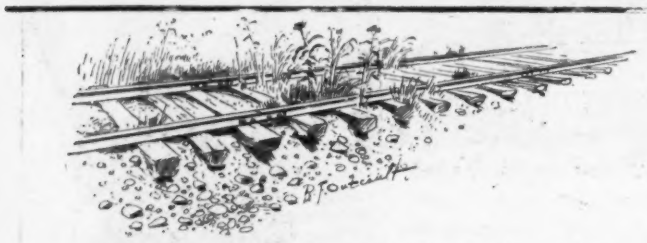
The Electrical World has given more than usual attention to the subject of electric traction, a course which is warranted by the prominent position this branch has assumed in the electrical field.

The transmission of power is a subject whose importance is shown by the protracted discussion it caused and the in-

OPENING OF THE PORK AND BEANS TELEPHONE LINE BETWEEN CHICAGO & BOSTON
AFTER THE CAR IS OVER
BROADWAY CABLE
BEANS
IN THE TRAIL OF THE DEADLY CABLE
1893
THE ELECTRICAL WORLD 1893 VOLS. XXI AND XXII
THE MOST VALUABLE SOUVENIR OF THE YEAR
THE MAN WHO WRITES ARTICLES ABOUT THE DEADLY TROLLEY
ELECTRICAL FOUNTAINS FULLY DESCRIBED IN THE ELECTRICAL WORLD JAN. 21ST & MAY 13TH
INTERNATIONAL ELECTRICAL CONGRESS AUGUST 21ST 1893.
FIRST APPEARANCE OF THE STOPPER LAMP
SOME LAMP SUITS
BOSTON
ST LOUIS
MILWAUKEE
HARTFORD
CAKE
R.F. Outcault

1893 AS IT APPEARS TO THE ELECTRICAL WORLD'S ARTIST.

terest it excited at the recent International Congress of Electricians. The greatest example of power transmission is, of course, the Niagara Falls plant, and work has been rapidly progressing on this installation and within the past few months the great question of the electrical system to be adopted has been settled and the contract for the generators let. Prof. Forbes, the consulting engineer of the project,

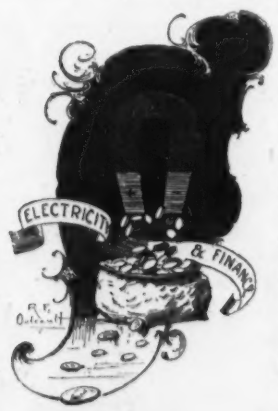


THE CHICAGO AND ST. LOUIS AIR LINE.

has finally announced the principal details of the construction. A large three-phase plant is now being installed in California, and other transmission of power plants have been erected in this country and abroad.

The alternating current is coming more and more to the front, and each year it pushes further into the field of its old rival, the continuous current. During the present year the various questions connected with its practical application have been thoroughly discussed and the battle of the phases waged more merrily than ever. Improvements in alternating current motors, both abroad and in this country, have broadened their field of application. That this subject has been well covered a glance at the indexes to the half-yearly volumes of The Electrical World will show. Articles have appeared under such names as C. E. L. Brown, Behn-Eschenberg, Arnold and Emil Huber from abroad and Elihu Thomson, Patten and Kennelly in this country.

The World's Fair in itself, even if nothing else of importance in the electrical field had occurred, might well be sufficient to mark the year 1893 as an eventful one. It was early seen that the electrical features of the Fair would prove to be among the most attractive and that the Exposition would indeed serve as a monument to electrical progress. It is hardly necessary to recall here the part that electricity played in the Exposition, as that subject has recently received such full treatment in these columns. Even before the Fair opened The Electrical World sent a representative



of its editorial department and its special artist to Chicago, where they remained for a number of months, and the splendidly illustrated descriptions of the important electrical features and exhibits, presented often in advance of all its contemporaries, only served to substantiate its claim for enterprise and progressiveness.

The International Electrical Congress was in many respects the event of the year, and has been so fully covered in these papers that its work and its results must now be well known. The Electrical World distributed at the Congress an issue of 60 pages devoted especially to the interests of the meeting and containing portraits and biographical sketches of the official delegates, and an elaborate directory to Electricity Building and other features of the Fair. It was enabled through its seven representatives at the Congress to present the most interesting and complete report of the proceedings yet published.

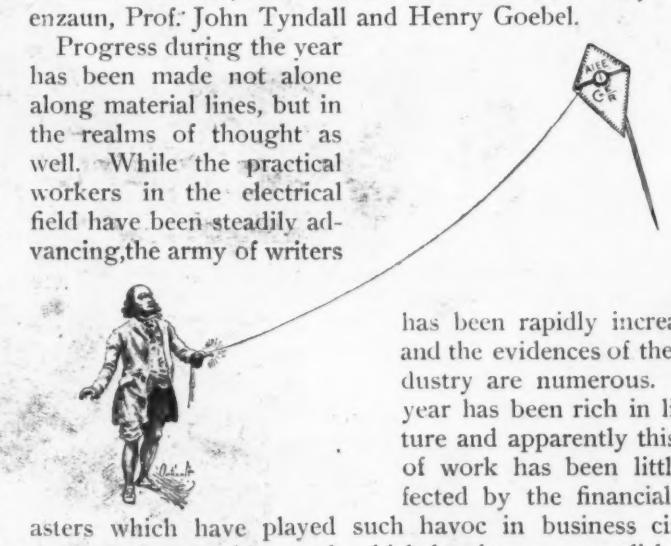
The year 1893 will long be remembered as one of widespread financial distress. The electrical industries have suffered in common with all the others, yet it would seem that their chastisement has been somewhat less severe. The great majority of the electrical firms, and those more or less connected with the industry, have weathered the storm handsomely, or at least safely, and the few who have gone under were, in most cases, bubbles that were better pricked now than at some future time. In this connection it may not be inappropriate to call attention to the opinions on "How the Electrical Industries Withstood the Stress," which The Electrical World gathered from prominent men in every quarter of the field and presented to its readers some months ago.

WERNER SIEMENS.

The General Electric Company has been the greatest sufferer from the business depression and has been buffeted about in the stock market without mercy. In The Electrical World of January 7 we find its stock quoted at 111 1-8, while in the last issue of the year it is recorded at 36 3-4. Whether the company will be able to pass through this crisis without reorganization or disintegration is a question which many are asking.

The necrology of the year contains many names familiar in the electrical world, including those of Dr. Norvin Green, president of the Western Union Telegraph Company; Prof. Moses G. Farmer, Dr. Werner von Siemens, Anthony Reckenzaun, Prof. John Tyndall and Henry Goebel.

Progress during the year has been made not alone along material lines, but in the realms of thought as well. While the practical workers in the electrical field have been steadily advancing, the army of writers



has been rapidly increasing and the evidences of their industry are numerous. The year has been rich in literature and apparently this line of work has been little affected by the financial disasters which have played such havoc in business circles. A brief glance at the work which has been accomplished in both book and periodical literature may prove interesting.

Electric book literature during the past year has received numerous accessions, of which the most imoprtant is J. J. Thomson's "Notes on Recent Researches in Electricity and Magnetism"—a long-promised supplement to Maxwell's great work. Another contribution in the same line is the concluding portion of Gray's work on "The Theory and Practice of Electrical Measurements." Jackson's "Electro-Magnetism and Construction of Dynamos" furnished a much needed text-book for colleges, while Kapp's "Alternating Currents of Electricity" and "Dynamos, Alternators and Transformers" bear out the reputation of this author for writing books of equal value to the student and the practical man. Cox's "Continuous Current Dynamos and Motors," Hawkins & Wallis's "The Dynamo, Its Theory and Design" and Weymouth's "Drum Armatures and Commutators" are three useful contributions on the design of electrical machinery, and Preece & Stubb's "Telephone" and Hopkins' "Telephone Lines" are the best works yet published in English on telephony. Kennelly's "Theoretical Elements of Electro-Dynamic Machinery," Kilgour's "Electrical Distribution" and Ram's "Incandescent Lamp" are noteworthy addi-

tions to their respective subjects, as well as Benjamin's "Voltaic Cell"—an exhaustive compilation on chemical batteries. New editions were issued during the year of three standard works, Crosby & Bell's "Electric Railway," Bedell & Crehore's "Alternating Currents" and Davis "Standard Tables for Wiremen," and of Ayrton's "Practical Electricity" and Salomon's "Electric Light Installations." Two volumes of Houston's Advanced Primers completed a series of three books for the first-year electrical student and the general public, and Hering's "Electricity at the Paris Exposition" added another historical work to electrical literature.

Periodical literature has also been rich in valuable contributions to science and art. A glance through the pages of The Electrical World for the past year will give some idea of the quantity and quality of this material. In addition to the articles already referred to, the following may be mentioned as some of the more important: The completion of the concluding sections of P. Mottelay's Chronological History of Electricity, and of the series of articles on Electricity in Agriculture; Laboratory Notes, by Lieut. F. Jarvis Patten; Nomenclature, Symbols and Abbreviations, by E. Hospitalier; Conductors and Insulators, by Prof. R. A. Fessenden; Theory of the Transformer, by Drs. Bedell and Crehore; Capacity and Induction of High Potential Circuits and Electromagnetic and Electrostatic Hysteresis, by C. P. Steinmetz; The Most Economical Age of Incandescent Lamps, by Hering, Thomson, Roberts, and others; Technical Education in Europe, by F. C. Perkins; Rope Driving, by Prof. J. J. Flather; Comparison of Different Lighting Systems, by Otto Frick; The Economical Operation of Street Railway and Lighting Plants, by J. B. Cahoon; The Simplification of Alternating Current Formulae, by A. E. Kennelly; and many others of equal importance and interest.

Rural Electric Roads.

The recent report of the Ohio Road Commission to Governor McKinley pays considerable attention to the subject of electric roads for rural transportation. With the advent of the electric car, it says, has come a development along a line totally unexpected, through its extension into suburban and rural districts. There is no reason why these railways should not be carriers of freight as well as passengers, and it is not at all visionary to surmise that as the steam railway superseded horse power for long hauls, so the electric railway may supplant it for short hauls. That more electric roads will be built, that they will be almost innumerable, in fact unlimited, is evidenced by every indication, so that the problem of building the wagon road is made easier and easier by reason of the shortened distances for which horses may be profitably used for purposes of transportation. By introducing the iron rails and inanimate power for rapid transit and to take the heavier loads, the problem is solved.

A comparison of the cost will show that the average expenditure required to macadamize a road or make it hard and durable with any kind of material is fully equal to the cost required to lay down steel rails over which not only wagons and carriages propelled by horses, but cars propelled by electric power, might also go at a greatly reduced cost in transportation. Having given the cost of construction—which is the same in each kind of road—and the cost of moving the vehicle being so much less over the steel rail than any other kind of road, and knowing also that the cost of inanimate power is less than the cost of animal power, it seems clear that the substitution of steel rails for macadamized roads, and inanimate power for animal power, is destined to cheapen our transportation in the most effectual manner.

The report argues in favor of assisting the extension of electric traction by providing free tracks over country roads, thus placing it on an equality in this respect with wagon traffic.

On the Fall of Pressure in Long Distance Alternating Current Conductors.

BY A. E. KENNELLY.

THE paper on "Impedance" in vol. X., No. 5, p. 175, Transactions of the American Institute of Electrical Engineers for April, 1893, show that the fall in pressure over a line of resistance R ohms carrying a sinusoidal current of I amperes is IR volts multiplied by an impedance factor depending upon the disposition and size of the wire. It has also been pointed out that while the "drop" so computed is a minimum in regard to current wave type, being augmented by any distortion from the sinusoid, it is on the other hand a maximum in regard to the circuit, since the fall in pressure measured at load terminals cannot be greater and will usually be less than the fall of pressure as measured and computed between the far and near ends of the line, owing to the phase variation of pressure along the wire. These two opposing sources of error tend to neutralize and on short lines may be usually neglected, or when specially desired, corrections can be applied for each when sufficient data for the current lag and wave outline in the load are forthcoming.

For short aerial lines, say not more than five miles in length, the application of the electromagnetic impedance factor is therefore competent to practically determine the fall in alternating current pressure.

But when the aerial line is long, or is of even moderate length and underground, so that it possesses appreciable static capacity, and particularly if the working pressure is high, the influence of electromagnetic capacity upon the drop is no longer paramount and electrostatic influence may not be ignored, while the effect of leakage may also call for attention.

An obvious approximate method of treating the new problem is to assume that all the capacity, also all the leakage, is collected and connected at the middle point of the line, and then to consider these as derived impedance circuits. The effect of these shunts upon the main circuit can be computed by the ordinary rules of impedances. This plan while fairly successful and always useful as a check, is often unsatisfactory because it is not rigorous, and the extent of its error is left in doubt.

It is the object of this article to show how the rigorous computation for the fall of pressure in lines of known resistance, inductance, leakage and capacity, carrying sinusoidal currents can be most simply carried out.

Suppose a generating station, A, supplies a consumption point, B, at a distance of L miles or kilometres through two wires in metallic circuit, or through one wire with ground return. At B there are transformers or translating devices operated at a pressure u that it is usual to keep nearly uniform. Under this pressure at any given load a certain effective current of i amperes will traverse the apparatus at an angle of lag β. In practice the current is often so far distorted from the sinusoidal type, especially at light loads, that the angle of lag is not clearly defined, but we are compelled to sacrifice some accuracy in detail in order to arrive at determinations of reasonable facility and use. We therefore assume that the current and lag are experimentally known for the particular apparatus and load in accordance with the relation

$$u\,i\cos\beta \times \text{efficiency} = \text{Output}.$$

Having then given u, i and β at station B, the problem is to determine the corresponding pressure, U, and current I, at A, or at any intermediate point along the line.

Let r = the resistance of the line in ohms* per mile.
Let l = the inductance of the line in henrys per mile.
Let g = the leakage conductance of the line in mhos per mile.
Let c = the capacity of the line in farads per mile.
Let ω = the frequency $\times 2\pi$.
Let $j = \sqrt{-1}$

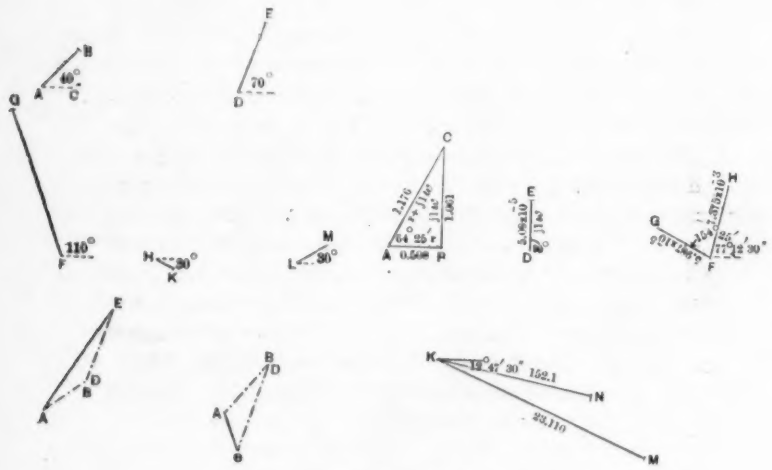
Then $$U = \kappa \cosh Lz + y\imath \sinh Lz. \quad (1)$$

and $$I = i \cosh Lz + \frac{\kappa}{y} \sinh Lz. \quad (2)$$

where $z = \sqrt{(r + j\,l\omega)\,(g + j\,c\omega)}$ and $y = \sqrt{\dfrac{r + j\,l\omega}{g + j\,c\omega}}$ (3)

As these equations involve plane vectors or the "complex quantities" of algebra, a preliminary discussion of their operations may first be admissible.

Let AB (Fig. 1), be a line of 2 units in length inclined at an angle of 40 degrees with the base AC, and let DE be a similar plane vector of length 3 units and angle 70 degrees. Then their product, $AB \times DE$, is the line or plane vector FG of length 6 and angle 110 degrees. The quotient, AB/DE, is HK of length 0.66 and angle −30 degrees, while the quotient DE/AB is LM of length 1.5 and angle 30 degrees.



FIGS. 1 AND 3.

Hence, to multiply plane vectors their lengths are multiplied and their angles added, to divide them their lengths are divided and their angles subtracted. Also to add or subtract plane vectors they are connected end to end. Thus $AB + DE = AE$ and $AB - DE = Ae$, DE being here laid off in the reversed direction.

The hyperbolic sine and cosine of any numerical quantity can be obtained directly from tables of those functions, but we have here to employ in equations (1) and (2) the hyperbolic sine and cosine of the quantity Lz, which is a plane vector. The following auxiliary formulas are requisite:

$$\sinh (a + jb) = \sinh a \cos b + j \cosh a \sin b \quad (4)$$

and $$\cosh (a + jb) = \cosh a \cos b + j \sinh a \sin b \quad (5)$$

We now proceed to the application of these formulae:

Example.—At station B transformers are supplied at a steady pressure of 10,000 volts effective and 100 periods through two No. 0 A. W. G. wires of copper in metallic circuit, suspended on high poles at an interaxial distance of two feet. The resistance of this conductor is 0.508 ohm per mile, the inductance 1.688 millihenrys per mile, the capacity 0.081 microfarads per mile, and the leakage negligible, or the leakage conductance 0 mhos per mile. To find the pressure and current at A, distant 20 miles from B, when a full load of 50 amperes is sustained with a lag of 10 degrees at B.

* Or per kilometre if L is expressed in kilometres.

This metallic circuit may be divided by the imaginary line OO, Fig. 2, into two halves, each as though inde-

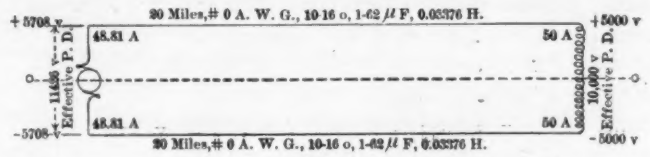


FIG. 2.

pendent of the other, and operating with ground return at 5,000 volts. We have then:

$\kappa = 5{,}000.$
$i = 50.$
$\beta = -10.$
$r = 0.508.$
$l = 1.688 \times 10^{-3}.$ $\quad \therefore \quad l\omega = 1.061.$
$c = 8.1 \times 10^{-8}.$ $\quad \therefore \quad c\omega = 5.09 \times 10^{-5}.$
$\omega = 628.3.$
$L = 20.$

The first step is to determine the plane vector z.

The steps are indicated in Fig. 3. AB represents r, BC $l\omega$, and AC the vector sum $(r + j\,l\omega)$, whose angle is 64° 25′, and length 1.176. Again DE is $c\omega$, and since the horizontal component, g, is zero, the quantity $(g + j\,c\omega)$ remains DE simply. The product $(r + j\,l\omega)\,(g + j\,c\omega)$ or $BC \times DE$ is $FG = 5.987 \angle 154° 25' \times 10^{-5}$, and the square root of this product is $FH = 7.7375 \times 10^{-3} \angle 77° 12' 30''$, or the quantity z in equation (3). Lz is consequently L times the line FH or $0.15475 \angle 77° 12' 30''$. Again the quotient of AC/DE is the line $KM = 2.311 \times 10^{-4} \angle 25° 35'$, and the square root of this plane vector is $KN = 1.521 \times 10^{2} \angle 12° 47' 30''$. This gives y in equation (3).

The next step is to find the hyperbolic sine and cosine of Lz as indicated in Fig. 4. The line OP represents the plane vector Lz and its components are found to be $OQ = 0.03426$ and $PQ = 0.1509$. This length PQ represents the circular measure of an angle whose arc can be found in trigonometrical tables to be 8° 38′ 45″. Taking formula (5), $RS = \cosh 0.03426 \times \cos 8° 38' 45'' = 1.0006 \times 0.9887 = 0.9883$ and $ST = \sinh 0.03426 \times \sin 8° 38' 45'' = 0.03426 \times 0.1503 = 0.005151$, so that RT is $\cosh Lz = 0.98835 \angle 0° 18'$.

Similarly, with the aid of formula (4) $VW = \sinh 0.03426 \times \cos 8° 38' 45'' = 0.03426 \times 0.9887 = 0.03387$ and $WX = \cosh 0.03426 \times \sin 8° 38' 45'' = 1.0006 \times 0.1503 = 0.1504$, so that VX is found to be $0.15417 \angle 77° 18' 45'' = \sinh Lz$.

FIG. 4.

Substituting the above in formula (1) we find as indicated in Fig. 5.

$U = 5000 \times 0.98835\ 0° 18' + 1.521 \times 10^{2} \angle 12° 4' 0'' \times 50 \angle 10° \times 0.1542 \angle 77° 18' 45'' = 4942 \angle 0° 18' + 1173 \angle 54° 31' 15''$.

$U = AB + BC = AC$ which is found by summing components to be $5708 \angle 9° 54'$.

Also by formula (2)

$I = 50 \angle 10° \times 0.98835 \angle 0° 18' + 6.576 \times 10^{-3} \angle 12° 47' 30'' \times 5000 \times 0.1542 \angle 77° 18' 45'' = 49.418 \angle 9° 42' + 5.072 \angle 90° 6' 15''$, and

$I = DE + EF = DF$, which by summing components is found to be $48.81 \angle 3° 49'$ amperes.

The effective pressure at A being represented in Fig. 6

FIG. 5.

by AC and the effective current by DF, the angle between them is 13.° 43′, and the energy delivered to the line is IU cos. 13.° 43′ = 270.7 kilowatts. The energy absorbed at B is iu cos. 10°, or 246.2 kilowatts (on each side of the circuit), and the loss in this transmission 24.5 kilowatts. This loss can only exist as i^2r, the value of which must fall between $(50)^2 \times 10.16 = 25.4$, and $(48.81)^2 \times 10.16 = 24.14$ kilowatts, the mean being 24.7, confirming the above calcula-

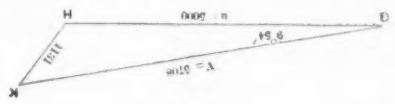


FIG. 6.

tion. The total pressure at A is thus 11,416 volts and the current 48.81 amperes.

The drop on each wire is 708 volts.

The drop due to IR on a similar continuous current circuit would be 496 volts.

The impedance factor being 2.316 for these wires, the drop in conductors would be by electro-magnetic impedance principles 1,150 volts. The actual drop between far

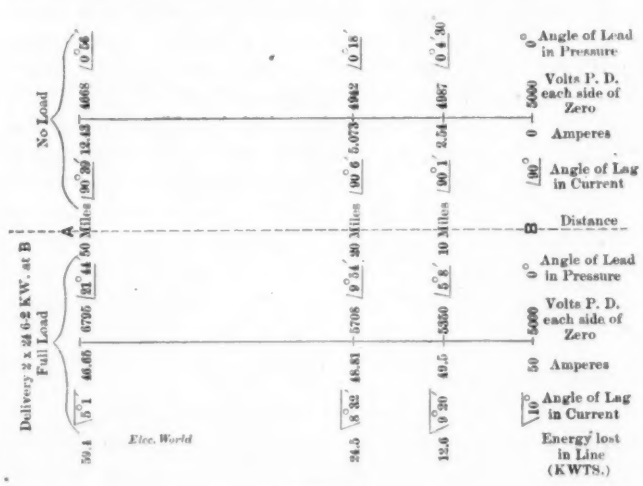


FIG. 7.

and near ends of one line is shown in Fig. 7 to be GK=1,131 volts.

The influence of electrostatic capacity has reduced the drop in the line, as measured between line terminals, from 1,150 volts to 1,131.

As one more example, suppose that with 10,000 volts maintained at B the load is entirely removed. In this case the second term disappears from equation (1) and the first term from equation (2), so that we have at once

$$U = 5{,}000 \times \cosh Lz = 4942 \angle 0° 18'$$

and $I = 6.576 \times 10^{-3} \times 5000 \angle 12° 47' 30'' \times 0.1542 \angle 77° 18' 45'' = 5.037 \angle 90° 6' 15''$.

The energy absorbed at A is UI cos β on each wire = $4942 \times 5.037 \times \cos 90° 5' 57''$, or 44 watts. The impedance of a condenser having the same capacity as the line, viz., 1.62 microfarads at 100 periods, would be 982.3 ohms, making the line current in this case 5,000/982.3=5.09 amperes, in practical accordance with the above.

Figs. 8 and 9 illustrate the effect of distance and of pressure upon the drop in the lines of the wire considered in the foregoing examples.

In Fig. 8 the current and pressure are marked off at 10, 20 and 50 miles from B at a supposed full load of $50 \angle 10°$ amperes and at no load, with 10,000 volts total effective de-

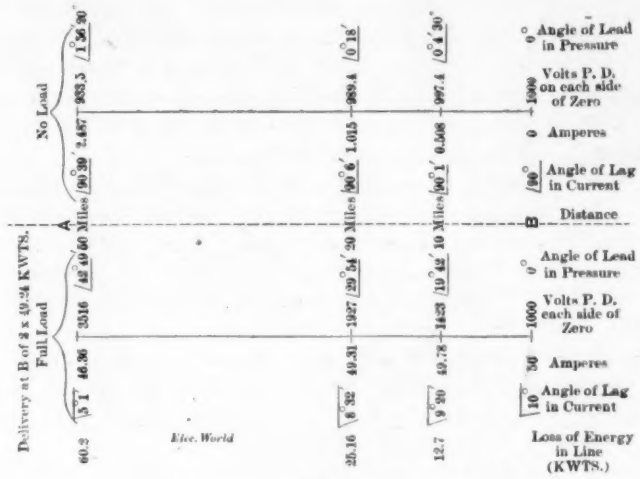


FIG. 8.

livery pressure, or 5,000 positive and negative, measured from the zero point or load center. Fig. 9 gives the corresponding figures for 2,000 volts total delivery pressure, or 1,000 volts on each side of zero. The drop is in the latter case much too great at full load for the conditions of ordinary practice, but comparison of the two series shows how much the drop may be reduced in long-distance transmission over such wires by the employment of high pressure with a given current strength; for the electromagnetic effect is practically unaltered, while the neutralizing electrostatic effect is correspondingly increased. At no load the pressure here arises along the line.

If the conductors vary in size it is still possible to follow the consequences, for if, say, at C, twenty miles from B, new sizes of wire reach thence to A, the pressure and current at C can first be determined for a given load at B, and then the computation can be repeated from C to A under the new conditions.

How far the results of such computations are practically affected by distortions in current and pressure from the sinusoidal type it would be interesting for operators of long-distance circuits to observe.

To Mr. Oliver Heaviside is due the credit for the first published solution of the differential equations upon which formulas (1) and (2) are based.

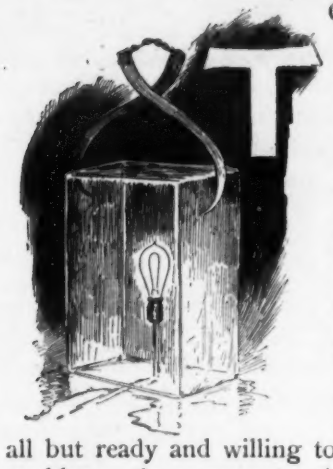
The Northwestern Electrical Association.

A special effort has been made to make the coming meeting of the Northwestern Electrical Association the most interesting yet held. Mr. Carroll Collins, the president, will open the sessions at the Pfister Hotel, Milwaukee, at 2 p. m. on January 17; an evening session will be held on that day, and morning and afternoon sessions the next day. The following papers will be read:

New Things in Electricity, by W. W. Low, Pres. Electric Appliance Co., Chicago; Essential Station Instruments, by Prof. Jackson, Madison; Economical Use of Transformers, by Forman Collins, Vice-President "Western Electrician," Chicago, and J. McFadden, of the General Electric Company, Chicago; Corliss Compound Engines, by E. L. Debell, Sheboygan; Advantages of Direct Connection, by W. N. Stewart, Siemens and Halske Electric Co., Chicago; How Shall Members Buy Supplies, by H. C. Thom, Madison; Supply of Electrical Power from Central Stations.

Light Without Heat a Possibility of the High Frequency Machine.

BY LIEUT. F. JARVIS PATTEN



O the speculative mind none of the possible future applications of electricity is more attractive and none so full of immediate interest as the possibility that seems almost within our grasp of obtaining light without heat, of making the light waves without the heat waves that have thus far always been at the same time the companion and the burden of all artificial light.

The time is ripe, and the exact science of the day seems all but ready and willing to give the analysis of two great problems, the answer to either of which would stand the crowning achievement of a century of progress in the application of nature's secrets to the requirements of daily life. One of these—the navigation of the air—seems to be a mechanical problem only, while the other—the production of light without heat—we may as confidently say is only a question of properly handling the electric current.

Nature presents us with beautiful examples of both solutions, but guards jealously the key to her method of operation, by which well-known forces are made to do the apparently impossible thing, and it is equally beyond our science to-day to explain how the bird soars aloft on motionless wing and how the glow worm emits a gleam of light without a ray of heat. But they do it, and the many imitators of the bird will soon be equaled in number by those who are chasing the firefly's secret.

What nature does with nature's forces man should and doubtless will be able to do with a full knowledge of those forces and a better comprehension of the methods by which nature applies them. Who shall say which is the more difficult accomplishment, the production of an artificial ruby or the production of an artificial light without heat? There is no certainty, indeed, that the latter will not come from the hand of the chemist first. We are only too prone to hastily write that down as the impossible which is simply not yet done and our last achievement as the most difficult of all accomplishments.

Let us not, however, forget that the chemist has striven for more than a century to make the artificial stone with commendable success, and the mechanic has striven a century to navigate the air, while the electrical engineer has wrestled but a comparatively short time with the problem of light without heat, and has already shown that the solution, far from being impossible on the lines of his attack, is, indeed, a reasonable expectation of another decade of electrical advance.

Tesla's experiments have not only shown the production of light by methods entirely new, methods entirely free from the wasteful process of chemical combustion, but he has set the scientific minds of two continents thinking upon the possibilities of high frequency phenomena and the reduction of laboratory results to a practical form.

When a theory, advanced to explain a natural phenomenon, is consistent with all its various manifestations and is contrary to no established hypothesis, we are bound to accept that explanation until some inconsistency is discovered or a better one is given.

Such a theory, thus far uncontradicted and supported by daily increasing and strengthening evidence, tells us that heat and light are merely the attendant phenomena of a high state of atomic vibration of the particles of a solid or gaseous body, that they are distinct and may be independent phenomena of this state of molecular agitation, and so might be separately produced.

Thus, the state of a body being hot is the result of a certain state of agitation of the particles of which the body is composed, and the state of being luminous or incandescent is merely the result of another and higher state of vibration of the same particles. Artificial light, as we know it, is produced in a roundabout fashion by causing the substance to be heated and generally consumed, in which condition of chemical change or combustion the particles are thrown into a state of violent agitation producing light. In all such cases the particles or atoms of the body necessarily pass through all the lower stages of vibration before that one is reached at which the mass appears luminous or incandescent.

The higher state of agitation can be brought about in a variety of ways. A piece of cold iron may be beaten with a hammer until it is sensibly warm to the touch—more hammering will considerably increase the internal agitation until it emits a dull red light, and if the hammering is continued with sufficient vigor it will eventually become white hot and intensely luminous—thus there seems to be two entirely independent manifestations of the internal agitation of the particles—heat and light.

The heat and light derived from a burning gas jet is explained in a similar way, but not exactly the same. In this case we start with the potential energy of chemical attraction. Instead of the powerful blows delivered by the hammer we have in the latter instance an infinite number of invisible but rapid and incessant blows delivered by the oxygen atoms of the air as they rush into the flame and collide with the hydrogen and carbon atoms of the gas, being impelled to this action by the powerful force of chemical attraction. The physical effects are practically alike in both cases, though in the latter they are not so plainly apparent to ordinary observation. In the electric lamp the light of the carbon filament is merely an attendant result of the heat produced by the resistance that the filament opposes to the passage of the electric current, and the light given off we find is a mere accident of the transformation that is taking place between the forces at work—electric energy is being changed back again to heat energy in the filament. We know that light vibrations are far more rapid than heat vibrations and the interesting question is, Can we not obtain the high-rate light vibrations without first making the low-rate heat vibrations that absorb so large a proportion of the energy expended? For the light itself costs practically nothing; it is the heat we pay for in every case. There is encouraging evidence that this can be done by properly delivering the electric current, by which means we may be enabled to throw a gas or possibly a solid substance into such a high state of molecular agitation that it will shine without being necessarily hot or consumed.

Tesla has shown us how currents of high potential and high frequency may be made to cause a sort of bombardment of the atoms in certain forms of matter so vigorous as to render them luminous with little or no heat, and certainly without any combustion of the material. These remarkable phenomena are the result of a molecular agitation set up by an electric current that itself has a correspondingly high rate of alternation or frequency. This phenomenon has been produced in a rarefied gas inclosed in a glass bulb and in a piece of copper wire so agitated by the vibrating currents that luminous streams emanate from its surface and a sheet of flame is made to flow from the bare hand that neither heats nor consumes anything.

Speaking of the so-called "brush discharge," Tesla says: "We know that the phenomenon is due to the agitation of the molecules at the terminal (electrode) and we are led

to the conclusion that could we reach sufficiently high frequencies we could produce a brush which would give intense light and which would resemble in every particular an ordinary flame."

Thus the problem seems largely to rest upon the production of very high frequency currents, as the potential can generally be increased to almost any desired limit.

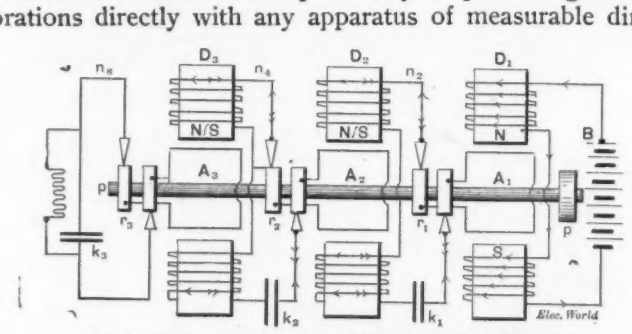
There has been, however, thus far but one known way to produce very high frequency currents, and that is by the disruptive arc discharge, with the attendant electrostatic effects. Such discharges, though possibly of very high frequency, have their own fixed rate and are practically beyond control as to the rate of vibration or alternations used, and it seems equally impossible to determine with any degree of accuracy what the frequency or rate of such a discharge really is.

It would certainly seem that all these conditions of high frequency currents must be brought under perfect control before we can hope to obtain from them the practical results that it is reasonable to suppose they are capable of giving us.

We should be able to produce any rate of alternation or frequency required in a perfectly uniform and reliable manner, to promptly place the frequency at a certain value and hold it there as long as desired, or to change it to another rate at pleasure.

Considering what has been done with an erratic and unmanageable frequency, what may we not expect from a frequency that may be fixed at any desired rate and held absolutely uniform or varied at pleasure?

Quoting again from a recent lecture of Mr. Tesla's, he says: "When we consider the enormous rapidity of light vibrations we realize the impossibility of producing such vibrations directly with any apparatus of measurable dimen-



PATTEN MULTI-FREQUENCY MACHINE.

sions, and we are driven as the only possible means of affecting the atoms of a gas to the use of electrostatic force. By varying the electrostatic force we can agitate the atoms and cause them to collide with evolution of heat and light. It is not demonstrated that we can accomplish this effect in any other way."

In the light of recent developments there seems indeed to be another and possibly much better way of obtaining electrical alternations of potential of enormously high frequency, and this by a comparatively simple electro-mechanical device—a sort of dynamo, in fact, of modest dimensions and moderate cost—but capable of giving perfectly uniform oscillations of potential at inconceivable rates, so that if these wonderful effects of luminous gases and solids without combustion only require controllable high frequency currents, then such effects can probably be obtained from comparatively simple apparatus.

I refer to an invention of my own which I have christened the "multi-frequency machine," from which electric oscillations of almost any desired rate can be had by purely mechanical means and entirely independent of disruptive arc discharges or electrostatic effects.

This machine, which was described at some length in my "Laboratory Notes—X.," * is indicated by diagram of parts in the figure herewith, and is interesting by reason of the possibility it holds out of obtaining any frequency of alternating E. M. F. desired, and of either maintaining the frequency uniform or changing it as desired between enormously wide limits, and all this with but little change of speed.

Without going into the analysis contained in the article cited, it will suffice to say that the machine has a series of successively connected armatures all carried by the same spindle, and each armature from the first or initial one on gives a frequency just double the preceding, though all revolve in single or two-pole fields at the same speed.

Such a machine can be made with its moving armatures so small that it can be driven by a steam turbine at 500 revolutions a second; this would mean 1,000 reversals of E.M.F. a second at the first armature (assuming, of course, only a two-pole field), and the successive armatures would give frequencies respectively of 1,000, 2,000, 4,000, 8,000, 16,000 and so on up to the 10th, which would give 1,024,000 reversals a second, while the 19th would give 524,288,000, and the 20th over one billion reversals a second.

If, now, the machine speed were decreased one per cent. the first armature would no longer give 1,000 reversals a second, but 990, or one per cent. less, and all the successive armatures would give just one per cent less than the former amount, so the 10th armature would give 1,013,760, instead of 1,024,000 in a second of time, and any other change of the machine speed would give a corresponding change throughout all the values. So this simple device not only promises enormous frequencies from mechanical apparatus, but admits of an immense range of choice and of the frequency rate quite beyond the possibilities of disruptive arc discharges or the management of electrostatic effects.

If we have, then, here the possibility of producing an oscillating E. M. F. of any desired rate in a perfectly uniform and controllable way, may we not hope by its aid to set up an electrical bombardment of the atoms of a substance that will cause it to give light without heat as the result of our attack?

* See "Electrical World" of Nov. 18, 1893.

Defective Flywheels.

BY CHARLES H. MANNING.

The article by Mr. W. Stuart-Smith in The Electrical World of December 2, 1893, takes a very just view of the flywheel question. Why should men who would not dream of using cast iron in the tension member of a bridge use such an untrustworthy metal in the rim of a flywheel where it is subject, not only to much higher tension, but more sudden changes of load?

Since the bursting of the flywheel here, on October 15, 1891, we have abolished cast iron flywheels, and now have three wooden rimmed ones, the first being 30 feet in diameter, with a 110-inch face, replacing the wrecked one, and the other two but slightly smaller.

We have also built one 14 feet in diameter, with a 30-inch face, and rim 12 inches thick of plate steel, each plate being 1-2 inch thick, 30 inches broad, and extending half way around. This mass is riveted through and through, and I think it would be impossible to run it at a high enough speed to burst it. Its normal speed is 93 revolutions per minute, and it acts as a flywheel for a 1,500-h. p. tandem compound engine.

All these wheels are giving entire satisfaction, and I for one want nothing more to do with cast iron flywheels.

Amoskeag Mills, Manchester, N. H.

Honors to Helmholtz.

The Institution of Civil Engineers (London) has elected Prof. von Helmholtz an honorary member. With a total membership of 6,490, there are only 15 honorary members.

The Most Economical Age of Incandescent Lamps.

BY LIEUT. MANNING K. EYRE.

IT is something fearful to see the lamentable ignorance displayed by the management of many large central stations and innumerable isolated plants as regards the most economical use of that small appliance which all these plants are mainly installed to operate; namely, the incandescent lamp. Knowledge concerning this useful article finds its way slowly into the mind of the central station manager, and, apparently, not at all into that of the average consumer.

The subject to be discussed in this paper, namely, the advisability of renewing lamps after a comparatively short period of their life, is so well worn that it would seem useless to attempt anything original. Mr. Carl Hering has covered the ground most thoroughly in an article entitled "The Most Economical Age of Incandescent Lamps," which appeared in the Transactions of the American Institute of Electrical Engineers, February, 1893. It is proposed to take up the subject in the first part of this article from a purely commercial standpoint and put the facts in such a shape that they will be readily understood. The latter part of the article will deal with the subject more mathematically and, perhaps, less interestingly; but, it is hoped, may prove of some value to technical readers.

The present method seems to be for a central station furnishing renewals to renew a lamp only when broken, or when it has dropped so much in candle power that the patience of the user is exhausted. How can it be proved to the average station manager that this is bad, hopelessly bad policy? He will tell you that he is using less current per lamp (although in many cases he is using more) and, as long as the customer does not growl, it is money in his pocket to run a lamp on ad infinitum. It does not take more than average intelligence to see that even from his own incorrect standpoint he loses, and loses largely. What is he competing with? What does he want? He is competing with gas and he wants more custom. If he would adopt the policy of giving his customers far better light, it would not be necessary to make a deal with the local gas company, as he would soon have all the custom he wants.

Every user of lamps, be he central station, isolated plant or ordinary customer, should break his lamp and renew it at such a time in its life that the cost per candle of light is least for the time the lamp has been used. Not the cost per lamp, but the cost per candle power. This is self-evident.

We are buying light, and we are buying it by the candle power, not by the lamp. We pay so much for 16 candles of light and so much more for 32 candles, and yet a user will start out with 32 candles of light that he has paid for, and he will keep right on paying for them when he is only getting 16 or 20 candles. To show the incorrectness of the station man's point of view, it is only necessary to glance at the curves showing the changes in current consumed, as shown in Fig. 2. As he voltage remains constant, and since (as a glance at the curves will show) the current throughout the 800 hours is practically the same as at the commencement of the lamp's life, the total energy imparted to the lamp throughout any period of 800 hours or less is practically constant. As a matter of fact, up to 500 hours, the mean energy consumed by the lamp is greater than the energy at the start. In actual figures, at 300 hours, the total energy being expended is 63 1-2 watts, as against 62 watts when the lamp was brand new. So, that with 1 watt more energy, we are getting 4 c. p. less light.

It is very evident that the advisability of breaking and renewing lamps early in their life is greater in localities where power is more expensive and less where power is cheaper; we must take, therefore, comparatively wide limits for the cost of power in order to completely cover the ground. The less the value assumed for the cost of power, the stronger will the argument be against breaking the lamps. But, in order to leave no shadow of doubt in the mind of any user of lamps that there is some point in the life of the lamp

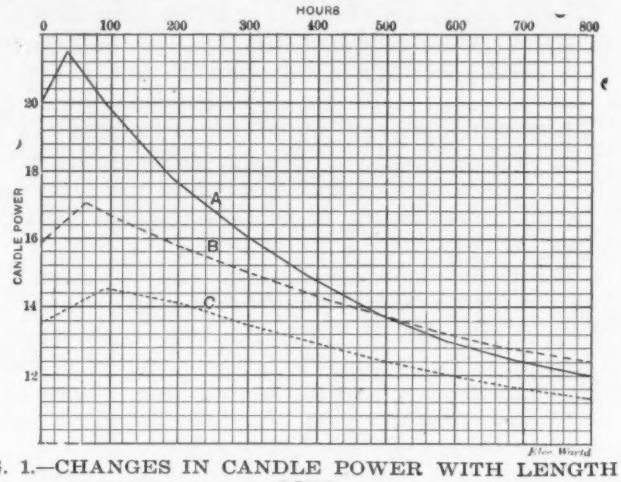


FIG. 1.—CHANGES IN CANDLE POWER WITH LENGTH OF LIFE.

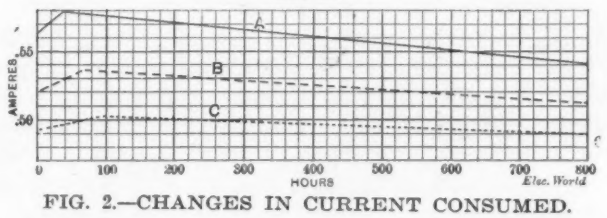


FIG. 2.—CHANGES IN CURRENT CONSUMED.

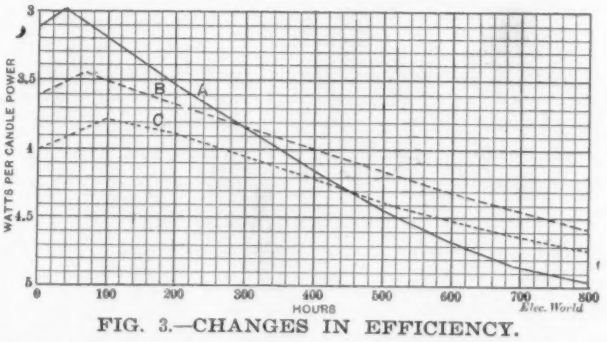


FIG. 3.—CHANGES IN EFFICIENCY.

where it is advisable to break it, and beyond which point it is actual loss to him to run it, the lowest cost of power assumed is such that it must appeal to even those who pay very little for the current they supply or receive. The assumed costs, above referred to, are 3 cents, 5 cents and 8 cents per electrical horse power hour delivered at the lamp; 3 cents is undoubtedly very low and 8 cents is not high; consequently, I have erred, if at all, on the conservative side. The cost of a lamp will be taken as constant throughout the calculations—35 cents.

The data used in the following table are the mean of a large number of careful experiments made by Prof. B. F. Thomas, and the results of which were published in the Transactions of the American Institute for May and June, 1892. The average candle power and efficiency are calculated from the data in the last column of Table V. of that paper. It must be remembered that all these results are the average of thirteen different makes of lamps, bought in the open market and carefully tested. It is presumable, therefore, that results based on these experiments will be commercially true.

The following table is an extract from the experiments re

ferred to, on which all the calculations made in the construction of Table II. are based:

TABLE I.

Life.	Percentage of Candle Power.	Watts Per Candle or Efficiency.
0 hours	100	4.2
100 hours	95.6	4.5
200 hours	90	4.8
300 hours	84	5.0
400 hours	78.4	5.3
500 hours	73	5.6
600 hours	68.6	5.9
700 hours	64.7	6.3
800 hours	62	6.6
900 hours	57.4	6.8
1000 hours ..... 1.05 11.6 .77	1.22	1.90

From the above table it is at once seen that the curve expressing the relation between watts per candle, or efficiency and the life of the lamp, is nearly a straight line, or, in simpler language, the efficiency decreases very nearly .3 watt for every 100 hours of the life of the lamp; consequently, the mean efficiency throughout any part of the lamp's life can be readily found.

I have taken a period of 3,000 hours, and calculated in the following manner how much it would cost the user of light per candle for that time if he broke his lamps at 300 hours, 400 hours or 500 hours, etc. Lamp cost, as stated above, 35 cents.

CASE I.—If renewed at 300 hours.

Mean efficiency during 300 hours (see Table D.) equals 4.6 w.
Mean candle power during 300 hours equals 14.9 c. p.

Since lamp is renewed 10 times in 3,000 hours:

Lamp, cost for 1 light, 10x35, equals.....$3.50

Cost of power for 3,000 hours, for 1 lamp at 3c. per

E. H. P. hr. $\frac{3\times3000\times4.6\times14.9}{746}$ equals..... 8.10

Total cost of lamp for 3,000 hours.....$11.60

Cost per C. P. of light, 3,000 hours $\frac{11.60}{14.9}$ equals..... .77

The above process is simply repeated for 400, 500, 600, etc., hours, and the result tabulated in column 4 of Table II., Columns 5 and 6 of Table II. are like results for costs of power of 5 cents and 8 cents:

TABLE II.

Lamp Smashed at	Total Cost.	Mean C. P. for 3000 Hrs.	Cost of 1 Candle of Light for 3000 Hrs. When El. H. P. Costs, 3c.	5c.	8c.
200 hours	$5.25	15.2	$0.88	$1.25	$1.79
300 hours	3.50	15.	.77	1.14	1.69
400 hours	2.62	14.4	.75	1.13	1.69
500 hours	2.10	13.9	.75	1.13	1.71
600 hours	1.75	13.4	.75	1.14	1.73
700 hours	1.50	12.9	.745	1.15	1.76
800 hours	1.32	12.5	.745	1.17	1.81
900 hours	1.17	12.	.76	1.19	1.85
1000 hours	11.6	11.6	.77	1.22	1.90

(To be continued.)

The Niagara Power Plant.

In referring to Prof. Forbes' paper on Electrical Transmission of Power from Niagara Falls, "The London Electrician" says: "The paper should never have been presented to an engineering society, and would have been premature even for a popular audience. The subject, as a practical problem, was clearly quite unripe for discussion. Many of the details were unanimously condemned by practical engineers. Mr. Ferranti's incisive and fearless speech was received with unusual applause, and while we echo his candid statement that no blame can be attached to Prof. Forbes, the important subjects on which he dwelt cannot be allowed to remain where they were left when the meeting rose. The less said about Prof. Forbes' reply the better. To say that the various criticisms have refuted each other is a very old device, and was quite inapplicable to this discussion."

False Economy.

BY J. B. CAHOON.

SOME time ago in an article on "The Economy of Small Central Stations" illustration was given of the failure of the plant to pay dividends through lack of economy in its operations, and it was there shown that by the rehabilitation of the plant under the intelligent supervision of a good electrical engineer these non-paying plants could be converted into good dividend payers. I thought at that time that the lighting plant spoken of was in a pretty bad shape, and so it was; but since that time I have run across a street railway plant which is in a much more chaotic and run-down condition than ever the lighting plant dreamed of being.

The history of the street railway plant was something as follows: In 1890 the road was in operation as a horse railroad with, approximately, 75 cars. In the following winter it was decided to equip a part of the road electrically, and 20 motor car equipments were contracted for and placed on the old horse cars. A power house was constructed and equipped with two 80-kw. Rae generators, belted direct to two 100-h. p. non-condensing Westinghouse engines, steam being supplied by a battery of four 125-h. p. boilers, fitted with mechanical stokers. This change over was made under the direct supervision of the president of the road, who, although he did not claim to be either an electrical or mechanical engineer, or even a steam engineer, did not think it necessary to secure the services of anything more than an ordinary dynamo tender to look after his plant and road equipment, nor did he consult any engineer as to his equipment; but simply bought the material and had it installed by his own force, with the exception of the overhead line, which was put up by an expert from one of the electrical companies. This was in the spring of 1891. Let us now follow this road in its operation and expansion through the following two years.

We find at the end of this time that the equipment of motor cars is doubled, i. e., that the road is now running 40 motor cars where before it ran 20. Let us see what the president, acting as his own engineer, has accomplished in this interval. As the demand of his road became greater he put in various new apparatus in his power house, as follows: First, he added a Cooper-Corliss, tandem, compound-condensing engine of 380 h. p., and concluded to put in a line shaft and belt from that to his generators, and also put in an independent Cooper condenser. From time to time were added two 350-h. p. tandem, compound-condensing Buckeye engines, one 1,000-h. p. Worthington independent jet condenser, one 1,000-h. p. Hall's live-steam purifier, a battery of three horizontal boilers of 100 h. p. each, and two 250-h. p. Manning upright boilers. The pumps for feeding the boilers were one Epping boiler feed pump, one Blake duplex boiler feed pump, one Worthington duplex pump, one Hancock inspirator and one Metropolitan inspirator.

It will be remembered that we started with two Rae generators of 80 kw. each, next were added two Edison generators of 150 kw. each, then one Westinghouse generator of 300 kw. capacity, and finally he decided it would be a good plan to put in lights for his power station, car barns, etc., and, therefore, got a 1,000-light alternator and a 50-light

2,000-c. p. machine, the last two of the T.-H. type. His ammeters were of the same three kinds as his generators, while the circuit breakers were all of the Westinghouse make and the lightning arresters of the Keystone pattern. At various times the president of the road secured men for the position of chief engineer for this plant, but as he persisted in running the power house himself even to the minutest detail, he has never succeeded in retaining an engineer for a longer period than a few months at a time.

I was indirectly interested in this road, inasmuch as I was asked to recommend a chief engineer for it, and knowing something of the conditions I recommended a most excellent man, who was not only a good steam engineer, but was also exceedingly well posted electrically, and who had had quite a number of years' practical experience in the handling of both steam engines and electrical apparatus. In talking the matter over with this gentleman, I outlined to him the characteristics of the president, and told him just what to expect, and said he must be prepared to meet the eccentric behavior of the president and get along with it as best he could, but he should endeavor all the time to bring up the condition of the plant to something like an economical one, in spite of the president—in other words, to reduce chaos to something like order.

It will appeal at once to the electrical engineer if he stops to consider with what this man had to contend. There were three different makes and sizes of generators to be run in multiple or any one to be run in multiple with any any other one, and these were to be driven by three different types and sizes of engines, with different systems of cut-outs and regulators, and, incidentally, steam was furnished by three different batteries of boilers of totally different makes, though this latter did not matter so materially. It is a well-known fact that it is exceedingly difficult to run generators of different makes in parallel, not only because of the different systems of windings, but of the different magnetic properties of the iron, which makes one generator respond more quickly to changes of load than the other, so that when a sudden load is thrown on to the power house the generator whose magnetic qualities permit it to pick up the quickest is the one to take the brunt of the overload, and, possibly, before the other generator can pick up and take its share of the load the first has taken so much as to literally work itself to pieces.

So, too, with steam engines of different makes, one responds quickly to the overload, having, as it does, a very quick responding and sensitive governor, while the other, with a totally different governing device, and with a different system of cutout throughout, may take an appreciable interval before it will respond to the violent fluctuations in load, such as are often seen in the power house of a street railway.

Going back to our plant again, it will be seen by summing up that the total horse power of the engines is 1,280, the boiler power amounts to 1,300 and the generator power, roughly speaking, to 840 kw., including the lighting plant. The actual average daily output required for running the 40 cars is 400 amperes, or at the rate of 10 amperes per car, which is about right for this number of cars in operation where the track is practically level. Of course the fluctuations are considerably more than this, and may even be doubled for brief intervals of time and under special conditions.

To obtain this output of 400 amperes they are at the present burning 14 tons of good quality steaming coal per day of 18 hours, and are using on an average 268 h. p. for the railway circuit and 48 h. p. for lighting power for one-third of the time, or an average horse power per day of 284. This gives a coal consumption per horse power hour of 5.47 pounds. As a Cooper-Corliss, or any good condensing engine, should give an output of one h. p. per hour for each two and one-half pounds of coal burned at least, it will be seen that this plant is consuming something over double the amount of coal that it should. I believe that both of the Westinghouse engines are laid up for repairs, as is also one of the 80-kw. generators, but the balance of the equipment is in condition for use, and is arranged so as to form what might be called by courtesy a duplicate plant, the last arrangement of which I heard being as follows. The line shaft was driven by the Cooper-Corliss 380-h. p. engine; near each end of this and back 60 feet were placed the two 350-h. p. Buckeye engines, with double driving pulleys, placed in line with clutch pulleys on the line shaft. To each of these engines were belted one 150-kw. Edison generator and one 80-kw. Rae generator, the idea being that in case of a breakdown of the engines they could shift the belt along and in that way run the four generators, either from the 350 h. p. engines or to the line shaft. The 50 light arc and the A 50 alternating were placed between the right-hand Buckeye and the Corliss engines and belted to the line shaft; this latter was extended through into an annex and the 300-kw. Westinghouse generator was installed there next to the coal pile, where it had every facility for accumulating coal dust on it. This generator was driven by a fixed pulley on the end of the line shaft, the distance between centres of generator and line shaft being 28 feet, and to drive this a 36-inch belt, which was used on the Corliss engine, was worked over into a 33-inch belt, and a new belt ordered for the Corliss. The result of this arrangement is that when the railway plant shuts down the lighting plant shuts down, and they consequently have to use oil lamps and gas to clean up with. To give the numerous changes and shifts that have been made in the apparatus during the interval that it has been in the possession of this road would be sufficient to drive an engineer not only wild, but crazy, as the president of the road seemed to have certain days periodically, when, according to his notions, it was necessary to change things around, and they were accordingly changed or the engineer left; sometimes one thing happened, sometimes the other.

The boiler room was not without its trouble, as was instanced by the fireman not taking kindly to the mechanical stokers, and, therefore, they failed to work satisfactorily, and were continually out of order, although there was no reason why they should have been had they been given ordinary attention. With the arrangement of feed water and the manner of firing, the Manning boilers primed so badly that it was impossible to use them as intended, and finally resort was had to the use of Hall's live-steam purifier as a steam drum for the Manning boilers, and in this way they succeeded in getting some service out of the boilers and fairly dry steam, although it strikes me as rather a unique use to make of a steam purifier. The president of this road would persist, in spite of the protestations of every engineer he had there, in employing the cheapest grade of firemen that could be obtained in the city, and to this fact is probably to be attributed the necessity for frequent repairs on the boilers as well as the general inefficiency of the boiler plant to furnish sufficient steam to run the station properly. This seems to be an absurd statement, but it is, nevertheless, a true one, that with 1,300 h. p. in boilers it was frequently the case that, owing to various mishaps, they could not supply sufficient steam to furnish 300 h. p. to the engines.

The original installation was faulty from an engineering point of view in that, while they knew that they must, in the course of a very short time, double if not treble their electrical equipment, no provision was made for such increase other than, perhaps, the president might have had this in mind in installing his boiler plant, which was, of course,

wildly excessive for the small output required for his first installation of generators. It is, perhaps, not well to criticise too severely the original installation, as not so much was known then about the proper proportions of a plant as at the present time, and, therefore, we might pass this by; but certainly when it came to the increase, any engineer would have advised the enlargement of the plant on the same lines as begun, i. e., with the same style engines and the same style generators, or else have recommended the sale of his first installation, and if the president wanted to buy other make apparatus, then fit his plant with this new make entirely to meet the new conditions.

Now, what will, I think, strike the reader as the only way to save this railway property from bankruptcy, is for this road to secure the services of a first-class electrical engineer and place the whole thing in his hands for entire reorganization and give him absolute charge over the entire steam and electrical part of the road, with the distinct understanding that the president is not to interfere in any way with the instructions of the chief engineer. The power house could be remodeled at a small outlay so that it could be placed on an economical basis, and if then attention is paid to the balance of the road, and a uniform equipment secured there, together with some consideration for the welfare of the public in the matter of decent cars, there should be no question but that this road could be transformed into a good dividend payer.

His Appeal Decided Against Him,

Mr. T. C. Martin has again been defeated in his contest with The Electrical World. When in April last the Court decided against him, he was not satisfied with the decision, and he appealed from it to the General Term of the Superior Court. This appeal came on for hearing early in December before Judges Freedman, McAdam and Gildersleeve; and after considering the appeal these three Judges concluded that the Referee's decision was right and that Mr. Martin had made out no case against this paper or Mr. Johnston. The opinion of the General Term, which was delivered on December 29 by Judge Gildersleeve, is brief, but to the point, as follows:

OPINION.

GILDERSLEEVE, J.—This is an appeal by the plaintiff from a judgment entered in favor of the defendants upon the report of a Referee dismissing the complaint. The action was brought to compel the specific performance of a written contract. The complaint contained the usual allegations of due performance of all the covenants, conditions and agreements to be kept and performed by plaintiff, and charges that the defendant Johnston failed to keep and perform the contract on his part. None of the evidence taken before the Referee appears in the record, as the case comes up on the exceptions filed to the Referee's report. The plaintiff has not appealed from the Referee's refusal to find facts in the plaintiff's favor, and plaintiff must, therefore, be held to acquiesce in the conclusions of fact reached by the Referee. Has the learned Referee upon the facts found reached a correct conclusion of law? The determination of this question seems to be the sole duty of the General Term.

In the sixteenth finding of fact the learned Referee found: "That the plaintiff failed to observe, and plainly violated the promises and agreements made by him in the said agreement." The Referee holds the plaintiff as guilty of affirmative acts in violation of the contract. This is an insurmountable obstacle in the way of the plaintiff's success on this appeal. Such a finding calls for a dismissal of the complaint. It would seem that plaintiff's proper course would have been to treat the contract as continuing, and sue for damages for the breach of Johnston.

All we now decide, however, is that upon the facts as found by the Referee, the complaint was properly dismissed.

For these reasons, and for the reasons set forth in the opinion of the learned Referee, which appears in full in the papers before us, the judgment must be affirmed with costs.

I concur, J. J. F. I concur, D. McA. J.

As will be seen by reading this opinion, Mr. Martin did not bring to the notice of these Judges the evidence given in his case. He appealed, as Judge Gildersleeve says, on "exceptions filed to the Referee's report"—that is, on technical legal objections. The "facts" were never satisfactory to Mr. Martin; and his whole litigation was born, nurtured and developed in the atmosphere of technicality. That, of course, not from any wish on his part, but from necessity. As the Judge also says: "The plaintiff has not appealed from the Referee's refusal to find facts in plaintiff's favor, and plaintiff must therefore be held to acquiesce in the conclusions of fact reached by the Referee." The Referee found the facts to be, quoting again from Judge Gildersleeve:

"That the plaintiff failed to observe, and plainly violated, the promises and agreements made by him in the said agreement."

And in this the Judge says Mr. Martin has acquiesced. What, then, was his appeal? As we said, something based on reasoning purely technical; and we will try to briefly explain it: We have pointed out in the report of this case, already published in The Electrical World, that Mr. Martin's action was founded on the fact that Mr. Johnston wrote him on June 7, 1890, that he, Mr. Johnston, wished the contract between them formally terminated at the end of the year 1890. It was, as a matter of fact, at that time already terminated and had been so for over three months, and Mr. Martin had been at that time securely installed in his present position as the editor of another journal. From what Mr. Johnston wrote, Mr. Martin wanted the Referee to decide that as against Mr. Johnston the contract employing him as editor of The Electrical World was in existence down to the end of 1890—and this in face of the admitted fact that Mr. Martin was out of his employment on The Electrical World and was actually employed as editor on another paper.

So far as fact and common sense are concerned, you might just as well ask a court of justice to decide that San Francisco is situated on the shores of the Atlantic Ocean, because some one had said something which might possibly imply that it was so, as to ask what Mr. Martin modestly requested to be decided for the purpose of helping him out of his awkward situation.

The Referee did not waste time on Mr. Martin's metaphysical conundrums. He said plainly and practically that all that "may be admitted without removing or reducing the difficulty, which, it seems to me, stands in the way of the plaintiff's recovery in this action."

Now comes Mr. Martin's technical appeal. He did not find fault with what the Referee did decide, but what he contended was that had he decided more the result to him would be less disastrous; that is, had the Referee decided that because Mr. Johnston in his letter of June 7 impliedly admitted that the contract was in existence to the end of 1890, this would or at least might in law overcome the effects of Mr. Martin's own "affirmative acts in violation of the contract." Mr. Martin was only dissatisfied with the Referee's conclusions because the Referee did not appease his desires in this respect. "Only let the Referee do as I want him to do," thought Mr. Martin, "and then see where Mr. Johnston and I will stand. It will be seen that though I may have violated my contract, Mr. Johnston admitted that I did not; and not on the facts but on Mr. Johnston's implied admission I plant myself." The Referee did not view it in this light; neither could three judges of the Superior Court. So Mr. Martin's appeal, based on this technical and narrow-minded view of the matter, did not succeed.

As suggested by Judge Gildersleeve, "The plaintiff's proper course would have been to treat the contract as continuing and to sue for damages for the breach of Johnston." This is what The Electrical World sought all through this controversy, to force Mr. Martin to do. But that involved the question of the rightfulness or wrongfulness of his discharge, and that question he always seemed to wish to avoid ventilating. We suppose that for the same reason he withheld from the Judges the evidence on this question, the absence of which from the record Judge Gildersleeve refers to.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL AND ELECTRICAL LITERATURE

COMPILED BY CARL HERING.

ELECTRO-PHYSICS.

Distortion of Wires by Oscillating Discharges.—In an article by Mr. Kennelly, in the Lond. "Elec. Rev.," Dec. 15, he refers to Mr. Bleekrode's article abstracted in the Digest, Oct. 14, and describes interesting tests made by himself, from which we extract the following: The bends in the wire do not appear to follow any law and are not confined to any plane, nor could they be controlled by a magnetic field of 1,000 units; the bends were the largest and the most abrupt with the most powerful discharges; the medium surrounding the wire, as air, water, oil or vacuum, does not seem to influence the effects, nor were the effects destroyed by hammering the wire into thin strips; the best results were obtained with wires of platinum alloyed with 10 per cent of iridium, having a diameter of .008 centimetre; some of the bends were so abrupt that they formed an angle of more than 90 degrees; microscopic examination showed the existence of holes or craters at the bend, sometimes on the concave and sometimes on the convex side; with continuous currents the distortions were very faint unless the current was applied suddenly. These observations suggest to him that the distortions are produced by the sudden expansion released, leave the small craters which were observed and caused the mechanical distortion.

Atmospheric Electricity.—In a note in the Lond. "Elec. Rev.," Dec. 15, attention is called to observations on Ben Nevis, which confirm Prof. Smith's theory that the potential is below the normal on the edge of a dissolving mist and above the normal on the edge of a condensing mist; when the summit becomes clear a strong current comes up the telegraph cable, which is grounded at the foot of the mountain, while when involved in mist the current is reversed; during a rain or snow the current invariably passes down the cable and on the cessation of the rain or snow there is generally the opposite effect.

Balloon Experiments.—"L'Ind. Elec.," Dec. 10, reprints in an abstract an Academy paper by Mr. Andre, mentioning briefly his experiments at high altitudes made in balloons; in his conclusions he states that in good weather it is certain that the electric field does not increase with the height, but that "the electric field is the same at the same instant along the same vertical"; he makes this statement provisionally, and desires to prove it by a subsequent ascension.

Radiation in Incandescent Lamps.—The "Elec. Zeit.," Dec. 15, reprints a paper of Dr. Gruner, in which he describes the results of tests intended to determine whether the constant in Weber's law for the radiation of solid bodies is the same for all substances; from the results of five different lamps he finds that the constant is the same for both black and gray carbon filaments.

Oscillations.— Mr. Blondel's mathematical article on "Oscillations in Cylindrical Conductors," mentioned in the Digest last week, is continued in "La Lum. Elec.," Dec. 9; he discusses self-induction and impedance.

Calculations of Alternating Currents.—Mr. Guilbert, in the first part of a mathematical article in "La Lum. Elec.," Dec. 9, describes the Steinmetz method as given in that author's recent Congress paper.

Reflection of Electric Waves at the End of a Conductor.—"La Lum. Elec.," Dec. 9, reprints a discussion by Mr. Poincare of the paper of Messrs. Birkland and Sarasin, mentioned in the Digest, Dec. 16.

Interference of Waves in Air.—The article mentioned in the Digest, Dec. 30, is concluded in "La Lum. Elec.," Dec. 9.

MAGNETISM.

Demagnetizing Watches.—The "Elec. Anz.," Dec. 10, reprints a paper by Mr. Bohmeyer; it is first necessary to find the position of the poles of a magnetized article, which is done by approaching the article to a small light compass needle, moving it exactly along the east and west line; if the steel is not magnetized it will not deflect the needle; a U magnet is then placed as far as possible east or west of the compass and in such a position as not to affect it; equal spaces are marked on this magnet from the poles to the neutral point; the magnetized article is then touched to these lines, beginning near the neutral point, and each time tested again until the magnetism is entirely neutralized; the object of the markings on the magnet is to obtain the effects of poles of gradually increasing intensity; each pole must be neutralized in this way. In a criticism of the paper it is stated that it would probably be better not to touch the magnet, but to bring the object to a greater or less distance from it.

Compensation for Hysteresis.—In an article in the Lond. "Elec.," Dec. 15, Mr. Vignoles refers again to this subject, intending to show that the Evershed method and that of Abdank Abakanowicz are really the same; he adds a figure showing the percentage difference of the readings of a compensated ammeter on reversals of the current, which is a nearly horizontal curve for the compensated instrument and a very rapidly rising curve for the uncompensated one.

Magnetic Field of a Current in a Cylindrical Coil.—The Lond. "Elec.," Dec. 15, abstracts a Physical Society paper by Professor Minchin.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Alternating Current Potentiometer.—A Physical Society paper by Mr. Swinburne is noticed in the Lond. "Elec.," Dec. 15; a quadrant electrometer with a double fishtail needle is employed, suspended by a tortionless fibre; the electrostatic attraction of the alternating voltage between the needle and one pair of quadrants is balanced by the force, due to the steady voltage between the needle and the other pair, the steady voltage being determined by a potentiometer and standard cell; for alternating currents a differential electrodynamometer, having one fixed and two movable coils and no controlling spring, is used; a direct current measured by the fall of potential over a small resistance is passed through one of the fixed coils, the alternating current through the other, while the movable coil is included in both alternating and direct circuits; when the two forces balance the currents are equal.

High Resistances.—"La Nature," Dec. 9, describes a comparatively simple and ingenious method of making high resistances, devised by Mr. Jona. A cylinder of hard rubber is coated with a paste made of unvulcanized rubber well mixed with lampblack (the proportions are not given); it is then subjected to vulcanization, which makes the paste adhere; it is then turned down in a lathe, making it as thin as is desired and leaving thick ends for the contact, to which metal binding posts are attached; for a diameter of about 5-8 of an inch a resistance of about 1 megohm may be obtained for every 4 inches; for still higher resistances the cylinder may have a screw thread cut on to it, the depth of which extends through into the rubber, thus forming a long thin spiral of the semi-conducting material; the contacts at the end may be made by embedding a coil of iron wire in the paste at the end of the rod before vulcanization.

Kruppin, a New Resistance Metal.—The "Elek. Zeit.," Dec. 15, contains an article by Mr. Dettmar, in which he gives results of numerous experiments with the new resistance material called Kruppin, which has been lately brought out by the firm of Krupp, of Essen. It has a very high resistance coefficient and is well adapted to be worked; the resistance is given as .71 to .76 when hard, and .81 to .85 when soft (although not so stated, it appears that this is the resistance in ohms per metre per square millimetre cross-section); the temperature coefficient is .0013, the curve for this is given; numerous experiments were made to determine the best form of resistance spirals for this material, and for every diameter it was found that a certain number of windings per unit of length gave a maximum value for the heat dissipated per unit length of spiral; for 13 millimetres diameter of spiral, for instance, the best result was obtained when the distance between the spirals was double the diameter of the wire; curves and formulas are also given for the amperes which these wires of different diameters can take before they will hiss when touched with the moist finger, one of the curves being for currents lasting one minute and the other for a continuous load; the results of the observations are given in a table, which also gives the resistances and the lengths per ohm for different diameters; the nature of the metal and its composition are not given.

The Continuous Current Arc as a Standard of Light.—Mr. Blondel's Congress paper is concluded in the Lond. "Elec.," Dec. 15. He gives the results of experiments and concludes that for homogeneous carbons the intrinsic brilliancy may be considered constant and equal to about 160 bougies decimales (candles) per square millimetre; commercial carbons, however, may exhibit appreciable differences; when the arc hisses this brilliancy is decidedly lower by about 10 or 20 per cent. at least; but such a standard does not at present fulfill the necessary conditions for an absolute standard. The paper is discussed editorially in the same issue.

Measurements at Central Stations.—In the "Elek. Zeit.," Dec. 15, Dr. Kallmann gives the first part of a paper on measurements at central stations; in the present portion he describes what he calls the differential principle, in which voltages, for instance, are measured by galvanometers connected across between two branched circuits, like in a Wheatstone bridge; by this means it is claimed that high voltages can be measured with low voltage instruments and with a greater degree of accuracy.

Terminology.—In an article on this subject in "L'Ind. Elec.," Dec. 10, Mr. Guillaume discusses the inconsistency of several terms used in mechanics. Regarding electrical terms he states that if there are two points on a circuit, separated by a distance R, and having respectively the potentials A and B the difference AB is indifferently called "difference of potential" and "fall of potential;" but the last term is applied also to the quantity $1 \div R(AB)$; for the latter he suggests the name "slope of potential" (pente de potentiel), corresponding to the German "potential genfaelle."

Coefficient of Self-Induction.—The Lond. "Elec.," Dec. 15, abstracts briefly a Physical Society paper by Prof. Minchin, on the calculation of the coefficient of self-induction of a circular current of given aperture and cross-section.

Commercial Condensers.—In a communication to the London journals for Dec. 15, Messrs. Swinburne & Co. claim to have solved the problem of the manufacture of condensers on a commercial scale, stating that they have been making them for the past two years.

DYNAMOS AND MOTORS.

Starting Resistances for Shunt Motors.—Mr. Baumgardt, in the "Elek. Zeit.," Dec. 15, from a simple mathematical deduction shows that in order to make the resistance as small and as cheap as possible the starting current for the motor should be taken as large as possible; as even large motors will start in the fraction of a minute, heat radiation may be neglected, and he therefore bases his deductions only on a permissible rise in temperature; he shows that the length of the resistance wire will be smaller the shorter the time it takes the motor to start; also that the weight of the wire is smaller the shorter the time, that is, the greater the starting current.

Unipolar and Non-Polar Induction.—In a paper reprinted in the "Elek. Zeit.," Dec. 15, Mr. Vogel describes at some length experiments with unipolar machines of a new design, which, however, were inoperative; he attempts to show by means of these experiments how the lines of force act in such machines; among other things he states that his experiments prove that the lines of force remain with the pole pieces and are not carried along in the iron of the armature.

Crompton-Brunton Alternator.—The London journals of Dec. 15 give a short description of this new alternator, accompanied by a good illustration; the armature contains no iron and revolves; in general it resembles the Siemens type of 1878; among the advantages claimed are that the armature is easily accessible, as the two upper halves of the field magnets are hinged; the armature coils are easily replaced; the field is powerful and the armature reaction small; the commercial efficiency is said to exceed 91 per cent.

ARC AND INCANDESCENT LIGHTS.

Photometric Theory of Projectors.—Mr. Blondel's article, the first part of which was abstracted in the Digest, Dec. 23, is concluded in "L'Ind. Elec.," Dec. 10; it is devoted mostly to a theoretical discussion of the optical properties of various forms of projectors, and gives a few formulas; from a considerable distance a projector is exactly like a plane incandescent surface having an intrinsic brightness at every point equal to that of the source multiplied by certain optical coefficients. He discusses various features of projectors, and in comparing the different types he concludes that theoretically the parabolic reflector is the best, while in practice the Mangin is perhaps the most perfectly made, owing to the fact that the curves are circles; so much depends on the workmanship that it would be difficult to say in general which of the two would be the better. Regarding the Schuckert searchlight at the World's Fair, he calculates its intensity, assuming that the brightness of the crater is equal to 160 candles per square millimetre (see the abstract in the present issue on the "Arc as a Standard of Light"), and that the whole surface of the projector has this same brightness multiplied by the factor .70, and finds it to be 213,000,000 candles; even assuming a factor of only .6, it gives 183,000,000, that is, the same that would be produced by the crater of an arc having an area of 1.147 square metres; the figure given by the constructor, 190,000,000, he states, is therefore not unreasonable.

Vacuum Pump.—The "Elek. Zeit," Dec. 15, reprints a paper by Prof. Neesen, describing, with the aid of an illustration, his modified pump, which was already mentioned in the Digest, Nov. 18; besides what was stated there it appears that other advantages of this pump are that its action is continuous, rapid, and requires but little mercury; that there is no suction like in the Sprengel pump, but an expulsion of the air by means of small pistons of mercury; the volume of the air carried along is larger than that of the globules of mercury, which is the chief advantage of this pump; it differs also in the means by which the mercury drops are formed.

Alternating Current Arc.—Mr. Blondel's long serial in "La Lum. Elec.," abstracted in the Digest, Oct. 14 and 28, is given in abstract in the Lond. "Elec.," Dec. 15, in which ten of the sets of curves are reproduced.

Hanson Arc Lamp.—An illustrated description of this lamp is given in the Lond. "Elec.," Dec. 15.

TRANSMISSION OF POWER.

Transmission of Power at Niagara Falls.—The discussion of Prof. Forbes' paper is continued in the Lond. "Elec. Eng.," Dec. 15. Mr. Ferranti regarded the method of exciting in series as anything but the best; he had his doubts about the feasibility of the subway, as he believes an accident might lead to a complete breakdown of the system; he did not consider the frequency of 16.2, or even 25, the best, as considerable amount of lighting would be done, and the most practical way would be by direct transformation from the high pressure mains.

Niagara Falls.—In "L'Ind. Elec.," Dec. 10, Mr. Hospitalier gives a short description of the Falls together with some data and two interesting profiles, showing the size and depth of the five large lakes and the location of the tunnel.

Transmission of Power in Mexico.—The Lond. "Elec. Rev.," Dec. 15, publishes an illustrated abstract of Mr. de Arozarena's Congress paper, describing an interesting installation in Mexico.

Transmission of Power.—Prof. Unwin's sixth lecture is continued in the Lond. "Elec. Eng.," Dec. 15.

ELECTRIC RAILWAYS.

The Future of Electric Railways.—A recent lecture by Dr. Hopkinson is reprinted in abstract in the Lond. "Elec. Eng.," Dec. 15. Regarding the City & South London line he states that from experiments it was found that the loss in the line was about 11 per cent., the efficiency of the locomotives as a whole was 70 per cent., and the electrical efficiency of the entire system 62 per cent.; the trains weighed, with a full load of 100 passengers, about 40 tons, and the average speed between stations was 13.5 miles per hour; the cost of working, including all charges, during the last half year, was 13 cents per train mile; comparing this with a steam railway, the cost of steam traction per ton mile of train was about half this, but he states that this is an unfair comparison, as steam could not possibly be used in those tunnels, and that the real basis of comparison was the cost per passenger mile, in which respect electric traction had a great advantage over steam, as the dead weight is small. Regarding traction at enormously high speeds (which he does not seem to consider favorably), he calculates that the power required to propel an ordinary train 200 feet long at 200 miles per hour against the resistance of the air alone, apart from the frictional resistance, would not be less than 1,700 h. p.; he thinks the strength of the material at present at command would set a limit to the speeds which may be obtained; if speeds over 200 miles were required, he predicts that it would be more efficiently realized by regarding it as a problem of projectiles and not of ordinary locomotion.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Two-Phase System.—In Mr. Kennedy's serial in the Lond. "Elec. Rev.," Dec. 15 (see also Digest, Nov. 18, 25, Dec. 9, 23, 30), he describes converters for converting alternating into continuous currents; he appears to have little faith in commutating or rectifying devices, stating that they only give an intermittent current, and can be used for only small currents; he describes and illustrates the devices of Apollony and Hutin & Leblanc, which he calls "reproducers," as they change both the nature of the current and the voltage, as distinguished from transformers, which simply change the voltage, and converters, which simply change alternating into continuous currents; it consists essentially of two Gramme rings, one for the primary and the other for the secondary current, the latter being connected to a commutator as in the ordinary dynamo, the brushes for which are driven by a synchronizing motor and revolve synchronously with the alternations (for an illustration of the Apollony device see The Electrical World, Dec 10, 1892); he speaks of these as exceedingly effective and economical reproducers; he describes, with the aid of three illustrations, another device of Hutin & Leblanc, which, he says, is likely to be very successful; the primary and secondary currents are on the same ring, forming one closed magnetic circuit; there is a separate ring for each of the two primary currents, but the secondaries of both are joined to one commutator, the sections of one being coupled in series with the sections of the other, the separate coils at the same time having different numbers of turns; they are coupled so that the E. M. Fs. oppose each other at the points in contact with the brushes, so that no currents flow except in the external circuit; this he explains in detail; he considers this an "exceedingly elegant method, and one which seems very perfect;" up to 15 kw. there is no sparking at a commutator of only twelve divisions; he states that there is another method, equally good, if not better (presumably his own), which he cannot describe at present.

Rotary Field Apparatus.—Mr. Blondel's mathematical article on the elementary theory, mentioned in the Digest, Dec. 16, is continued at some length in "La Lum. Elec.," Dec. 9; he discusses the windings employed in practice, experimental methods for studying the rotating flux, and begins the section on a new method of calculations.

Polyphase Currents.—The serial in the Lond. "Elec. Eng.," mentioned in the Digest last week, is continued in the issue of Dec. 15; in it are discussed multipolar fields, the armature, the power developed, the efficiency and the coefficient of self-induction of the armature coils. It appears to contain nothing new.

Commutation of Alternating Currents.—Mr. J. H. Thomson, in the Lond. "Elec.," Dec. 15, describes a method in which the currents are commutated by the usual synchronizing commutator, but instead of connecting this directly to the mains, it is connected to them through condensers, the commutator being driven by a synchronizing motor; he calculates that each condenser must have a capacity of about 3.6 microfarads for each ampere of mean charging current, or 2.3 per ampere of maximum current; it would make little difference in the current in this method whether one cell was being charged or whether there are a hundred cells, and theoretically it would not affect the efficiency; errors in setting the brushes cannot produce violent currents; he has not yet had an opportunity of testing the method. In an editorial note there is thought to be no prospect that this method will be successful; it is stated that condensers absorb about one-fortieth part of the power represented by the product of the voltage at the terminals and the current following them.

Utilization of Town Refuse.—Mr. Tomlinson's serial is concluded in the Lond. "Elec. Rev.," Dec. 15. He states that he has shown the refuse of a town to be sufficient to supply the amount of light required by that town, even assuming the best recorded performances of destructors under sanitary conditions. Regarding the Halpin thermal storage system (see Digest, under Power Generator, Feb. 11) he states that the assumption that it makes destructors universally available is not correct, and that it is just as applicable for coal as for refuse. Taking a population of 20,000 the refuse will be about 4,000 tons per year, the evaporative power of which is 500 to 800 lbs. of water per ton of refuse, this being equal to 100 to 140 tons of coal; assuming 1.8 c. p. for 500 hours per year per capita and 10 to 20 lbs. of coal per kilowatt hour, 1,300 to 2,600 tons of coal will be required per year for the low tension continuous current system and the high tension alternating current respectively; the proportion is very small, but in many cases it may pay to utilize the power from the refuse as auxiliary; he states that thermal storage is not by any means the form of storage best adapted for town refuse, as it ties the central station down to a site in most cases unsuitable; the low temperature of the waste gases is not particularly applicable to this system of thermal storage.

Lightning Induction Discharges.—Referring to the notes on this subject in the Digest Oct. 28 and Nov. 25, describing a case in which a wooden table was set on fire by small lighting induction discharges, supposed to have taken place between the metallic threads in the trimming, Mr. Niels P. Jurgensen, sergeant of the Signal Corps stationed at Fort Snelling, Minn., writes us of a similar case which came under his observation. During a thunderstorm last summer one of their telephones refused to respond, and he found the trouble in the secondary of the transmitter induction coil, although nothing but the call bell was in circuit during the storm. At the brake the copper wire was entirely fused, and the insulation carbonized; the pasteboard between the primary and secondary was found punctured.

Alternating Currents.—In Mr. Guy's serial in the Lond. "Elec. Eng.," Dec. 15, he discusses alternate current working, explaining the difference between the two alternating amperes, the errors in measuring instruments for measuring these currents, inductive and non-inductive circuits, and the skin effect, but giving nothing new.

Tesla's Oscillator.—The "Elec. Anz.," Dec. 1, gives a short illustrated description of Tesla's oscillator for producing alternating currents by means of his new steam oscillator; the cuts include an outside view and a cross-section.

Motive Power and Gearing.—Mr. Carter's serial is continued in the Lond. "Elec.," Dec. 15; he discusses waste and useful power, load, load diagrams, load factors, prime and working costs and the economic law of design.

Cape Town.—According to the "Elek. Zeit.," Dec. 15, the central station, which has been erected by a German company, consists of an accumulator station located in the centre of consumption discharging through a five-wire system and charged from a station outside of the city, supplied with power by means of a turbine from a waterfall of over 600 feet in height, in conjunction with a direct coupled steam engine.

Saint Moritz.—"L'Ind. Elec.," Dec. 10, describes briefly the present installation in this town in the Engadine; as early as 1879 one of the hotels was lighted by Jablochkoff candles, the power being furnished by a turbine.

Edinburgh.—The proposal for that city, by Prof. Kennedy, in which both low pressure continuous currents and high pressure alternating currents are to be used, is discussed editorially in the Lond. "Elec. Rev.," Dec. 15.

Bockenheim.—"L'Ind. Elec.," Dec. 10, publishes a well illustrated description of this station described in the Digest Sept. 16, and referred to in the issues of Sept. 23 and Nov. 4.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Central Station in Paris.—"L'Elec.," Dec. 9, publishes at some length an illustrated description of the new station, known as the Gutenberg, for 6,000 subscribers, which forms one of the four central stations in Paris which are to replace the twelve former stations; the description is devoted chiefly to the architectural features and to the arrangement for the leading in and distribution of the wires in the building.

Pacific Cables.—The Lond. "Elec. Rev.," Dec. 15, mentions briefly the lengths and cost for four different routes from Canada to Australia, but none of which seem to include the Sandwich Islands.

ELECTRO-CHEMISTRY.

Preparation of Lithium by Electrolysis.—"L'Ind. Elec.," Dec. 10, publishes a note by Mr. Guntz in which he describes apparently successful experiments for obtaining metallic lithium by electrolysis from the fused chlorides; he finds that the amount obtained is greatest the lower the temperature; an impure salt containing chlorides of potassium and sodium gives much better results, which, he thinks, may be attributed to the consequent lowering of the fusing point; pure chloride of lithium melts at 600 degrees C., while a mixture with an equal weight of potassium chloride melts at 450 degrees, and a mixture of an equal number of molecules melts at 380 degrees; the best mixture is that made of equal weights of the two substances; the positive electrode consists of a ring of carbon and the negative electrode of a rod of iron placed inside of a glass tube about three-quarters of an inch in diameter; with 20 volts and 10 amperes at the end of 1 hour the lithium will be 1 centimetre above the liquid in the tube; the metal thus obtained is free from iron and silica, but contains one or two per cent. of potassium.

Alternating Current Electrolysis.—Messrs. Hopkinson, Wilson and Lydall, in a recent Royal Society paper, mentioned in the Lond. "Elec.," Dec. 8, conclude from experiments that about 0.1 coulomb suffices to fully polarize 150 square centimetres of platinum; this will liberate 0.00001 gramme of hydrogen, hence, 0.00000007 gramme of hydrogen serves to polarize 1 square centimetre of platinum; this quantity is probably a magnitude comparable with the distance between molecules of hydrogen when this body is compressed to a density comparable with the density of liquids.

Electric Treatment of Oils.—Mr. Levat, in an Academy paper abstracted in "L'Ind. Elec.," Dec. 10, states that when olive oils of an inferior quality are treated electrically they are clarified and the bad taste is completely removed; lubricating oils of a poor quality containing 5 per cent. of acids were also treated, and it was found that the acidity could be reduced to about one-fifth; the method is not clearly described, but it appears to consist of placing the oils around the negative electrode of a voltameter (presumably of the U type), and the action continued until "the column of water is completely electrolyzed."

Effect of a Long Rest on Accumulators.—Sir David Salomons, in the Lond. "Elec.," Dec. 15, states that he discharged some cells four years ago and set them aside, and now finds that the plates are as good as ever, only that their color is bad; there is no loss of paste or buckling, and he is assured that if the discharge has not been too rapid no harm is done by allowing them to stand for years; the plates are certain to buckle if they are not charged

in the ordinary way; a sure way to prevent this is to brush the positives with a stiff brush or slip of wood in order to remove the surface scale, after which they may be charged, but slowly at first.

Verdier Accumulator.—The Lond. "Elec.," Dec. 15, gives a short illustrated description of this acumulator; the plates are horizontal and contain active material in perforated troughs.

Purification of Sewage.—According to the Lond. "Elec. Eng.," Dec 15, the success of the Hermite process in France has led a number of municipalities to consider the subject of its introduction.

MISCELLANEOUS.

Firedamp Detector.—"La Lum. Elec.," Dec. 9, mentions the apparatus devised by Hardy, which is based on the principle that two organ pipes tuned to the same note will "beat" when one is operated by pure air, and the other by air mixed with gases: a telephone transmits these beats to any desired locality where they are magnified 400 times in loudness by a suitable microphone.

Heliotropism Produced by Sparks and Arcs.—The Lond. "Elec.," Dec. 15, mentions a Royal Society paper by Prof. Romanes, in which he describes his researches on the effect of intermittent light on the growth of plants which exhibit heliotropism; from this it appears that the heliotropic influence of electric flashes is greater than can be produced by any other artificial or natural source of illumination.

Physiological Effects of High Frequency Currents.—The Lond. "Elec. Eng.," Dec. 15, reprints a communication by Dr. Hedley from the "Lancet," Dec. 9; it appears to contain nothing new; in concluding he states "that physiological effects are proportional not only to the quantity of electricity, but also to its modality,"—that is, to the "mode in which such current is presented."

Lighting Currents for Medical Purposes.—The Lond. "Elec. Rev.," Dec. 15, contains a short editorial on this subject; it claims that continuous currents may be used safely and conveniently when properly protected, but that in unskilled hands protective devices afford little or no protection.

Welding.—The apparatus of Howard (presumably the same as is used in the Combs-Woods process, described in the Digest, April 1) is briefly described in "L'Elec.," Dec. 9; the important feature is that the arc used for the welding is kept continually in motion over the edges to be welded.

Welding Projectiles.—"L'Ind. Elec.," Dec. 10, publishes an illustrated description of the process used in Lynn.

Electric Furnace.—A more complete description of the latest form of the Moissan furnace mentioned in the Digest, Dec. 23 and 30, is given in "L'Ind. Elec.," Dec. 10, and "L'Elec.," Dec. 9.

Prizes.—The Lond. "Elec Rev.," Dec. 15, publishes a list of the prizes offered by a French Society for various inventions in the electrical field.

Keely and His Discoveries.—The Lond. "Elec. Rev.," Dec. 15, publishes at considerable length a review of the book having this title, by Mrs. Bloomfield Moore; the criticism is very unfavorable.

Biographical.—The London journals of Dec. 8 contain biographical notices of Prof. Tyndall. The Lond. "Elec. Eng.," Dec. 8, contains a short biographical notice of Mr. Killingworth Hedges, including a portrait, although not a good one.

The Digest for 1893.—The compiler's card index to the abstracts and references which have been published in this department from Feb. 4, 1893 (the first issue), to Dec. 30, inclusive, shows that the total number of abstracts and references is a little over 2,000. The largest number in any one department is about 300, under Central Stations, Plants, Systems and Appliances; the next largest classes are Electro-physics, Units, Measurements and Instruments, and Dynamos and Motors, with about 240 each. These abstracts and references are a summary of what was published in 836 issues of journals, of which over 550 were in a foreign language, thus averaging nearly 20 periodicals a week.

Prizes for Inventors.

Attention is directed by the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts to the fact that it may grant, or recommend the grant of, certain medals for meritorious discoveries and inventions which contribute to the promotion of the arts and manufactures. The character and conditions of these awards are briefly stated in the following:

The Elliott Cresson medal, founded in 1848 by the gift of the late Elliott Cresson. This medal is of gold, and by the terms of the deed of trust may be granted for some discovery in the arts and sciences, or for the invention or improvement of some useful machine, or for some new process or combination of materials in manufactures, or for ingenuity, skill or perfection in workmanship.

The John Scott legacy premium and medal ($20 and a medal of bronze), awarded by the city of Philadelphia. This medal was founded in 1816 by John Scott, a merchant of Edinburgh, Scotland, who bequeathed to the city of Philadelphia a considerable sum of money, the interest of which should be devoted to rewarding ingenious men and women who make useful inventions. The premium is not to exceed $20, and the medal is to be of copper, and inscribed "To the most deserving."

The control of the Scott legacy premium and medal, by act of ordinance of Councils in 1869, passed to the Board of Directors of City Trusts, and has been referred by the Board to its Committee on Minor Trusts, and that committee has resolved that it will receive favorably the name of any person whom the Franklin Institute may from time to time report to the Committee on Minor Trusts as worthy to receive the Scott legacy premium and medal.

The Edward Longstreth medal of merit, founded in 1889 by Edward Longstreth, machinist, and late member of the Baldwin Locomotive Works. This medal is of silver, and may be awarded for useful invention, important discovery, and meritorious work in, or contributions to, science or the industrial arts.

Full directions as to the manner and form in which applications for the investigation of inventions and discoveries should properly be made will be sent to interested parties on application to William H. Wahl, Secretary Franklin Institute, Philadelphia, Pa., U. S. A.

The Capitol Lighting Plant.

At the last session of Congress the Committee on Rules of the Senate enlisted the services of the competent electrical engineers for the purpose of ascertaining the amount of the appropriation necessary to establish an electrical plant for the purpose of illuminating the Capitol. Several reports have been made by the electrician, and definite action is soon to be taken by the Senate. It is said to be likely that the committee will recommend the immediate establishment of an electric lighting plant of sufficient power, not only for the Capitol building, but for its annex, the Maltby house, and the Congressional library, which is to be the largest building of its kind in the world, and which, by reason of its uses, will require the best class of illumination.

To accommodate such a plant, it will be necessary to

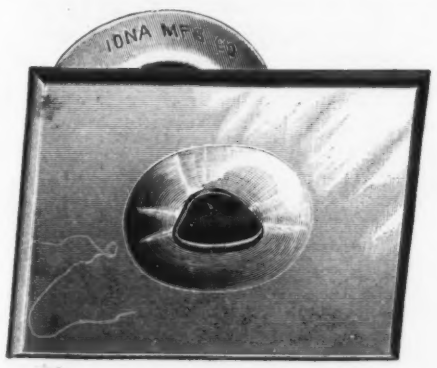
locate the engine and dynamos in a structure erected for this especial purpose. The location of the power house is now being carefully considered, and the decision will probably be reached very soon. The house will be ornamental in appearance, and will be of sufficient size to contain not only the eight dynamos necessary for the present, but also for other buildings that may be added to the group clustered around the Capitol, notably the home for the Supreme Court.

A careful estimate has placed the original cost of the building, the machinery, the wiring and the general installation of the plant at $200,000. This will insure the work to be of the best character and the plant to be of sufficient size to furnish all the light that can be used in the buildings and the grounds. This latter is a most important item in the calculation, for at present there is an utterly inadequate illumination of the great park. It is not certain whether the grounds will be lighted by arc lamps or groups of incandescent globes. But this is a mater of detail to be settled afterward.

A rough estimate that has already been made of the cost of maintaining the new plant, which will do not only the work now done by the gas and electric plants in the Capitol building, but also the entire work of lighting the new library building and the Maltby house, shows that it will cost in the neighborhood of $19,000.

Iona Flush Switch.

We illustrate herewith the flush switch made by the Iona Manufacturing Company, 236 Congress street, Boston, Mass., which is not only particularly convenient to wire, but makes a neat appearance when put in the wall, there being no screws in sight. The mechanism is the well-known snap and ratchet movement, which is simple and always reliable. The switch is made in single or double



FLUSH SWITCH.

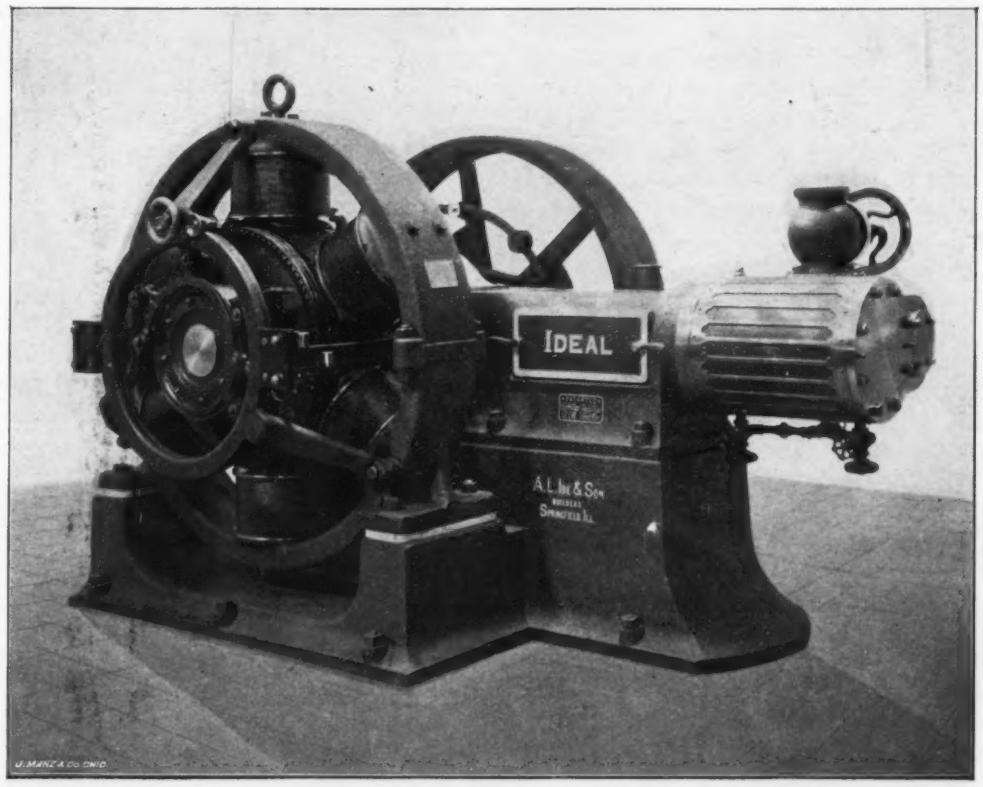
pole, singly or with several switches on the same face-plate, in nickel plate or fancy colors to match interior decorations, for which purpose it is particularly applicable.

Direct Connected Engine and Dynamo.

The state of perfection at which the latest types of steam engines have arrived is shown in nothing so clearly as in the increasing demand for automatic types of engines to be directly connected to dynamos. The fluctuations in load, especially in street car service, are so great and so numerous —fluctuations of 25 to 100 per cent. of the entire load occurring almost instantaneously—that it has taxed the inventive genius of our engine builders to the utmost to produce engines that will stand the strain. In the case of belt-driven dynamos a severe short circuit will usually cause the belt to fly off and thus relieve the engine, but a direct connected engine must not only be able to maintain a uniform speed under these sudden changes of load, but it must not fly to pieces if a short circuit brings the engine to a sudden standstill. That the day of the slow speed engines with deadly flywheels is past for electrical work is generally acknowledged. Where space is not very valuable, dynamos belted to high speed engines will continue to be used, but where space becomes a matter for grave consideration the future demand must be for direct connected engines as soon as engine builders can supply a suitable engine.

To meet this demand, the engine shown in the accompanying cut has been built by A. L. Ide & Son, of Springfield, Ill. The illustration is taken from one of three Ideal engines shipped by this firm for use in lighting the new Southern Hotel in St. Louis. Two of these engines had 14x14 cylinders, the third had a 13x12 cylinder. All were regulated to run at 275 revolutions. Each of these engines had a General Electric Company armature keyed on the crank shaft in place of the plain pulley. The construction of the armature and engine are such that no out-board bearing is required. The two 14x14 engines are to drive dynamos belted from the governor pulleys in addition to the direct connected armatures.

The points of superiority claimed by the builders of these engines for this form are as follows: They claim they will not vary over one per cent. in speed for a sudden change of 100 per cent. in load. They are perfectly self-contained



DIRECT CONNECTED ENGINE AND DYNAMO.

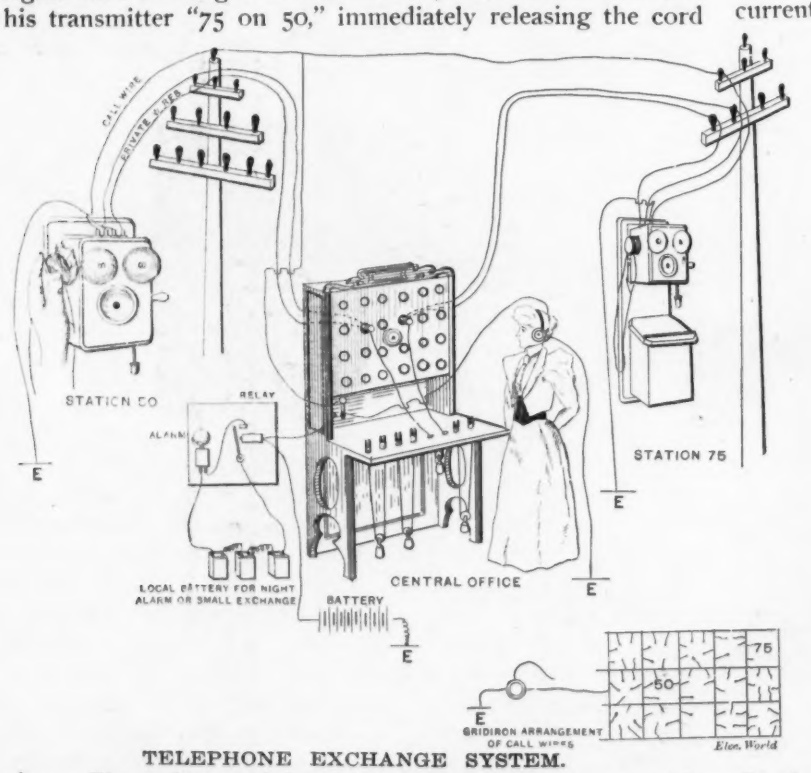
and balanced. Every engine was adjusted before leaving the works to run at its specified speed under full load and so balanced as to run without shaking with all anchor bolts removed. Excellence in workmanship and material—steel and bronze entering into its construction to an unusual extent. The engines are provided with the well-known Ideal system of self-oiling, which supplies all working parts with a constant stream of oil that is used over and over again. There is positively no oil scattered in any direction. The armatures are, therefore, entirely free from any danger that could result from a splash of oil. That these engines are peculiarly adapted to work in places where space

is valuable will be apparent from these dimensions: The 14x14 engines with armatures attached complete, as shown in the illustration, can each be placed in a box 68 inches high, 81 inches wide, 10 feet 3 inches long, and their rated horse power is 125. The 13x12 engine, 100 h. p., can be placed in a box 68 inches by 74 inches by 9 feet 11 inches.

Telephone Exchange System.

We illustrate a new exchange system now being placed upon the market by the National Telephone Manufacturing Company, 620 Atlantic avenue, Boston, Mass., which is of timely interest in view of the coming expiration of the Bell metallic diaphragm telephone patent.

As will be seen there are two wires from the central exchange to each subscriber, and a third or call wire, which is tapped for each telephone. This latter is always in open circuit until the subscriber pulls down the cord, which puts him in connection with the exchange, which grounds his call wire, enabling him to call "central" for desired connection. For example, suppose telephone number 50 desires to talk with telephone 75. Number 50 takes the receiver from its holder, places it to his ear, and pulls down the cord at the bottom of the bell box; this connects him with the third or general signal wire running to central station, and he then calls into his transmitter "75 on 50," immediately releasing the cord



TELEPHONE EXCHANGE SYSTEM.

after calling, always giving his own number last, to enable the operator to know who he is. When the cord has been released a sharp click will be heard, which assures that the call has been received; if the click is not heard, he should again pull down the cord and call "75 on 50," releasing the cord as before. When the click is heard, he replaces the receiver in its holder and rings up 75 direct.

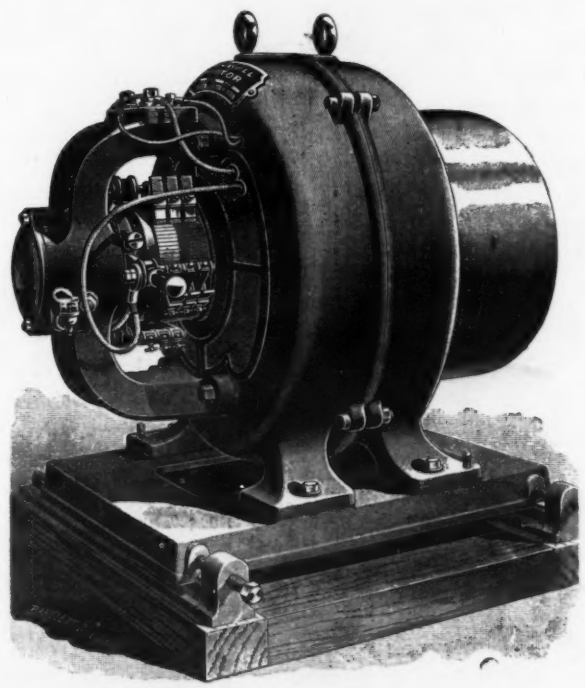
If, upon turning the crank of the bell, his own bell refuses to ring, it is evident that telephone 75 is busy talking with some other subscriber, and number 50 will have to call again later on, unless the operator should ring him up, having connected the line in the meantime. After conversation is completed, before replacing the receiver in its holder, number 50 should again pull down the cord from the bottom of the bell box and call into his transmitter, "disconnect number 50"; this must always be done, for, should another subscriber desire to talk with number 50, the operator would think his line still in use.

In small exchanges or central stations that may be located in a postoffice or store, or at any place where the continuous services of an operator are not warranted on the score of economy, a clerk or any other person may serve. The operator's instrument can be switched on to an alarm to sound a call when a subscriber desires to be connected, the subscriber pulling down his cord below the bell box and listening until his call is answered by "central," who will connect as requested.

The subscriber, when connected by "central," is enabled to do his own ringing up, as a call is not always promptly replied to. This feature alone permits the permanent operator to attend to answering calls, making connections without losing time in ringing bells and waiting for delinquents. This will also apply to a clerk or other person acting as operator; they will simply connect the wires leaving the subscriber to do his own ringing up. The subscriber is also assured of the fact that if he cannot ring up the person wanted it is by no means the fault of the central office. Metallic circuits must be used in connection with an exchange system if electric light or trolley wire poles are to be utilized.

The Lundell Motor and Interior Conduit Bushing.

The chief characteristics of the Lundell type of direct-current dynamos and motors, manufactured by the Interior



THE LUNDELL MOTOR.

Conduit and Insulation Company, 44 Broad street, New York, are embodied in the novel construction of the field magnet, whereby a single coil magnetizes all the pole pieces, and a strong protecting shell for the windings of both field and armature forms the magnetic circuit is furnished.

Referring to the illustrations, it will be noted that the two field-magnet halves when bolted together form a shell which completely protects the armature, the whole of the shell being utilized in the magnetic circuit. The cross-section of the shell equals the cross-section of the base of the pole pieces, so that no choking of the lines of force can occur at any point. Cast steel is employed for all these dynamos and motors. The single energizing coil not only reduces the construction of the machine to the simplest point, but by having only two terminals it is especially adapted to be placed in the hands of inexperienced users, as it avoids any possible mistake in connecting up or any bother or delay in examination when such becomes necessary. Another feature of the design is that the pole-pieces are magnetized directly,

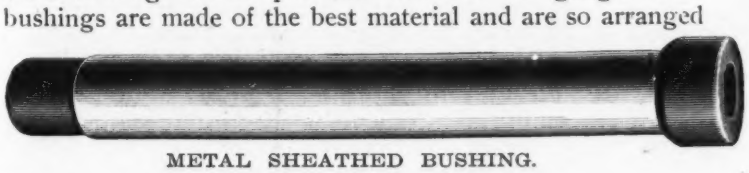
and, it is claimed, the resistance of the magnetic circuit thereby reduced to a minimum, thus effecting a considerable economy in the ampere turns of the energizing coil.

The armature adopted for these machines is of a modern Pacinotti form. This type of armature has in the past been subject to unfavorable criticism on account of the resultant heating of the pole-pieces, but it is now pretty well recognized that this heating was not due to the Pacinotti ring itself, but to the lack of knowledge with regard to its proper design, which is carried into practice in the Lundell machines by the employment of deep and narrow slots.

Notwithstanding the ironclad nature of the machine, the concentric position of the field-coil allows the armature to be withdrawn without disturbing either the field-coil or the pole-pieces. The openings around the armature at the ends of the field-magnets are, in the larger machines, covered with metal screens to protect the working parts, and to secure at the same time perfect ventilation. The commutator portion of the armature alone projects outside the screen, and is well protected by a strong bracket which carries the outboard bearing. The brushes are arranged diametrically around the commutator and the opposite brushes are in all four-pole machines connected together. They can be raised from the commutator when the machines are not in use.

The brushes of the two-pole type have a unique spring arrangement for pressing the carbon brushes against the commutator. The spring has its rear end placed in a curved slot at the end of the brush-holder; while its forward end in the shape of a T presses against the carbon which slides in the ways in the brush-holder. To remove the carbon, it is merely necessary to press the spring upward out of the slot, which releases it so that the T can be withdrawn, and the carbon slides out.

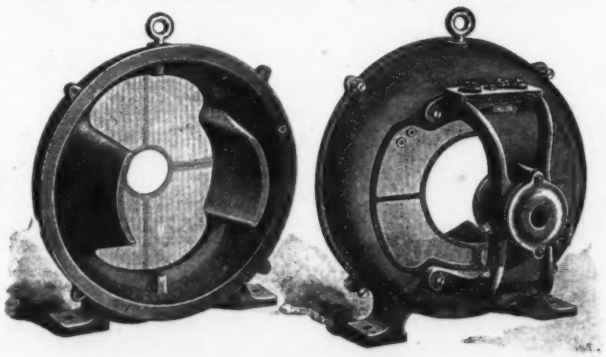
The bearings are constructed with mechanical accuracy, are self-oiling and are provided with a vision gauge. The bushings are made of the best material and are so arranged



METAL SHEATHED BUSHING.

as to be readily removed and renewed when worn out.

Recognizing also the necessity of continuous lubrication, oiling is accomplished by means of a number of rings which encircle the shaft and dip into the reservoir, thus continually feeding fresh oil to the bearing. In order that the attendant may know the exact condition of the oil, a simple oiling device has been added, consisting of an elbow with an oil-chamber, rising slightly above the normal level of the oil. The vertical arm of this elbow is so arranged that when the visual gauge is half filled the bearing is properly oiled. The glass tube is made so short that by no possible inadvertency



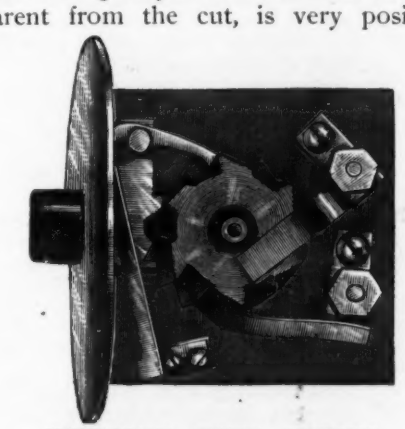
FRAME AND POLES OF LUNDELL MOTOR.

can the attendant pour in oil sufficient to flood the bearing and cause the oil to run out at the inner surface of the shaft and so go into the armature.

The insurance inspector rules of the Underwriters' International Electric Association require that electric light and power conductors must be protected when passing through floors, or through walls, partitions, timbers, etc., in places liable to be exposed to dampness, by waterproof, non-combustible, insulating tubes, such as glass or porcelain, and when passing through walls, partitions, timbers, etc., in places not liable to be exposed to dampness, by approved insulating bushings specially made for the purpose. In order to comply with these requirements the Interior Conduit and Insulation Company, 44 Broad street, New York, has placed on the market a metal-sheathed bushing, which we illustrate. The bushing is thoroughly waterproof and non-combustible, and has superior insulating qualities. The armor gives strength and durability, which neither glass, porcelain, nor vulcanized rubber composition possesses. It is more serviceable, requiring a smaller hole in beams and joists than porcelain or glass, and for this reason alone should meet with the approval of architects.

A New Electric Light Push Switch.

The particular feature of the push switch we illustrate, as seen by reference to the cut, is that it is operated by only one button instead of two, as is the case in the ordinary construction of push switches, the advantage of this method of operation being not only in the added neatness of the switch, but in its simplicity of action. The action, which is readily apparent from the cut, is very positive, and at



IMPROVED PUSH SWITCH.

the same time the switch can be manipulated with great ease. The break is quick, and made in such a manner that the switch cannot be left half off or on, and a short circuit cannot occur. The switch is known as the Standard Single Push Flush Switch, and is intended to take the place of any 5 or 10 ampere snap or flush switch, and is made in the regular 10-ampere singlepole and 10-ampere three-way styles. A third style is now under way and will shortly be ready for the market, to be known as the Standard Commutation Switch. In general appearance it is the same as the regular switch shown in the cut, but the contacts are so arranged that a light or group of lights, by the use of the commutation switch, can be controlled from any number of points without extra wiring; that is, a light or group of lights can be turned on or off from any three or more points independently. All of the Standard switches, which are manufactured by the Electric Appliance Company, Chicago, are compact and neatly made.

New Eook.

TABLEAU DES STATIONS ELECTRIQUES DE FRANCE. Paris: librairie polytechnique, Baudry et Cie, Editeurs, 15 Rue des Saint-Peres; Brochure of 32 pages, in quarto. Price, 3 francs 50 centimes.

This pamphlet gives under 27 heads details of all the central electric lighting stations of France, more than two hundred of which, it is stated, have never heretofore had data in relation to them published. Much of the data will be interesting to American electricians and central station managers.

Financial Intelligence.

The Electrical Stock Market.

New York, Jan. 2, 1894.

THE ELECTRIC STOCK MARKET is undergoing the usual holiday dullness, and with the exception of one conspicuous speculative stock there have been few transactions. Unlisted electrical stocks are particularly inactive, but suffer no decline in prices. About all of the trading is in the listed securities, which in some cases have fluctuated considerably, but to-day's closing prices differ little from those at the closing of last week's market.

GENERAL ELECTRIC STOCK was extensively traded in during the week, over 64,000 shares being sold on Wednesday, but the buying was in a bear rush, and at the close of the day's market the stock had sustained a net loss of 3¾ points. The stock closed at a rallying figure, however, and once during the day was down to 31¼, six points below the opening. Why the cause of the slump no one in the Street seemed to know, and the officers of the company would only make one of the usual general denials. Vice-President Griffin said: "The rumors affecting the financial condition of this company are absolutely false, and the direst rot. The facts are, that we have over $1,000,000 in the bank, and the floating debt is being chopped down at a tremendous rate. Of course, we could stand more business, as is the case with all other companies, but we are geting our share." This declaration stopped the bear landslide somewhat, but it seems as if it was only with these constant denials that the company could keep the stock from going to pieces. On Thursday the stock rallied a few points from the opening price. This rise was due to an order from Drexel, Morgan and Company to make heavy purchases of the security. On this buying there was a rush to cover by the shorts, and this brought a slight appreciation. On the same day it was reported that the Brush Electric Company had applied for a receiver for the General Electric Company at Cleveland, Ohio, owing to the General Electric Company's non-fulfilment of their obligations. This report was of course denied by the General Electric people, and the story classified as a bear trick. Nevertheless, these stories and rumors show to some extent the standing the stock has in Wall Street, and how readily all sorts of assailing yarns are put forth on the slightest provocation. There has been a heavy selling movement of the stock in Boston this week, and this, with the other rumors, has revived the story of a disruption of the trust, back to its original form in the Edison and Thomson-Houston companies. The announcement in another column of the centralization of the business offices and manufactory at Schenectady would seem to indicate the complete control of the New York faction of the company and the carrying out of their ideas. General Electric stock shows a net loss during the week of 3¼ points, it now being quoted at 33½ bid.

WESTERN UNION TELEGRAPH lost a few points at the beginning of the week, but regained a litle, so that it closed only 1⅝ points below last week's figure. The decline is due to the reigning dullness, with the usual declines, and the talk of an abandonment of special wires by large houses.

ALL OTHER ELECTRICAL SECURITIES remain unchanged both in quotations and business standing, and brokers declare no trading.

ELECTRICAL STOCKS, JAN. 2, 1894.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co. pref	15	15	16
" " " com	15	15	17½
Edison Electric Ill., New York	100	96	99
" " " 1sts	—	103	104
Edison Electric Ill., Brooklyn	100	99	102
" " " Boston	100	115	120
" " " Chicago	100	220	230
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	—	2½	5
" Bonds	—	80	85
" Ore Milling	—	5	12
Fort Wayne Electric	—	5	9
General Electric Company	100	33½	34
" " deb. 5's	—	71	72
Interior Conduit and Ins. Co	100	25	35
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	23½	24½
" " " pfd	50	41	43
Western Union Telegraph	—	82¾	82½

Special Correspondence.

New York Notes.

NEW YORK, Jan. 2, 1894.
OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Jan. 6, 1894.

SAMUEL ADAMS CHASE, the well-known representative of the Western Electric Company, sailed for Europe last week on official business.

STOLE A STREET.—The Union Railway Company began laying a track on One Hundred and Thirty-fifth street on Sunday, Dec. 24, thus avoiding service of an injunction.

THE METROPOLITAN TELEPHONE AND TELEGRAPH COMPANY gave a private view of its new exchange, at 95 Broad street, on Wednesday, Jan. 3. 1894, from 2 until 5 o'clock.

JUDGE GAYNOR has enjoined the Kings County and Nassau Electric Railroad companies, restraining them from constructing their lines, on the ground that the franchise was fraudulent.

THE AMERICAN STANDARD BATTERY COMPANY, which has been located at 29 Broadway, moved its offices on the 3d inst. to 66½ Pine street, where it occupies two floors, and will engage in the manufactury of its battery.

MR. S. FRIEDBERGER, treasurer of the Wakefield Electrical Engineering Company, 731 Reading Terminal, Philadelphia, Pa., was in New York last week, and reports business in Philadelphia and vicinity on the increase.

MR. F. S. DE RONDE, of the Standard Paint Company, 2 Liberty street, New York, who has been confined to his home suffering with a severe attack of the grip, has recovered and is now in daily attendance at his office.

MR. J. McFARLAN MOORE has an interesting article in the January number of "Frank Leslie's Popular Monthly" on a cruise on the U. S. monitor "Miantonomoh" in charge of the first electrical steering gear ever installed on a ship.

MR. DAVID CHALMERS, manager for S. W. Milbank, receiver of the A. B. C. Co., 67 Cortlandt street, New York, reports having made several large sales during the past week. The remaining stock is fast being disposed of to the "knowing ones."

MR. GEO. A. HILL, manager of the Typewriter Exchange, 10 Barclay street, New York, reports the sales of machines far in excess of the corresponding time last year. This is probably due to the fact that the Typewriter Exchange sells all makes of machines at a considerable discount.

MR. W. R. BRIXEY, manufacturer of Day's Kerite, is sending to his many friends and customers a neat memento of the season in the shape of an aluminium penholder. Mr. Brixey quotes: "The pen is mightier that the sword," and then very adroitly adds, "when the sword of competition is raised against kerite let this pen do its work."

MR. E. L. BABCOCK, president of the Falls Rivet and Machine Company, of Cuyahoga Falls, Ohio, while in New York, on Dec. 27, was run over by a truck on Church street, He was fortunately not very seriously injured, and was carried at once to Chambers Street Hospital and from there removed to the New York Hospital. On the 29th he left on the train for Cuyahoga Falls.

MR. E. B. WYMAN, Manager of the railway department of the Central Electric Heating Company, 26 Cortlandt street, New York, reports that it is working to its utmost capacity filling orders for electric heaters. There are to-day in the United States over 1,000 cars using this company's heaters, Brooklyn alone having in daily use 1,000 heaters, giving a uniform and comfortable degree of heat.

MR. NEWTON HALL, who has been connected with "The Electrical World" for the past two years, where he has had charge of the compilation of "Johnston's Electrical and Street Railway Directory," has severed his connection with the W. J. Johnston Company, to accept one as assistant manager of the American Electrical Publishing Company, 136 Liberty street, New York City. This company has been organized to publish the "Electrical and Street Railway Reporter," a new paper to enter the electrical field. Mr. G. G. McDuff, for some time a member of "The Electrical World" staff, will assume the managership of the new publication. Both Mr. McDuff and Mr. Hall are well qualified by their experience in the field for this work.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Jan. 1, 1894.

AN ELECTRIC PLANT is to be added to the new harness factory at Holliston, Mass.

THE BERLIN-MILLS COMPANY is about to add a new 150-h. p. engine to its pulp mill at Berlin Falls.

THE BOSTON ELECTRIC LIGHT COMPANY has declared a quarterly dividend of 2 per cent. payable Jan. 15.

THE W. S. HILL ELECTRIC CO. has just got out a very handsome calendar which is being mailed to its customers and friends.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, of Hartford, Conn., has opened a Boston office at 620 Atlantic avenue. Mr. F. B. Smith is in charge.

THE BROWN ELECTRIC COMPANY is presenting to its many friends a very neat calendar in the shape of a pug dog. As the supply is limited, first come will be first served.

BILLINGS & SPENCER'S plant in Hartford, Conn., has been running on full time with about two-thirds the working force. Orders are coming in more plentifully and better business is looked for soon.

THE PRATT & WHITNEY COMPANY'S extensive plant at Hartford, Conn., is running with about 800 hands, but on short time. The company believes that business will pick up and that January will show a gratifying increase.

THE NEW ENGLAND TELEPHONE COMPANY has decided to complete the work of putting its wires and cables underground in Newton, and has asked to be allowed to build the necessary conduits on Washington, Watertown, Chestnut, Hall, Greenough, Hillside, Vernon, Franklin, Jefferson, Peabody and Park streets.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, CHICAGO, Jan. 2, 1894.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, is meeting much success with "Mac Tape," which, it is claimed, has superior insulating qualities, is not affected by acids and is guaranteed to withstand the severest climatic changes. It sticks to the wire and not to the hands, and will not oxidize the wire. Its adhesive qualities are such that it is practically indestructible and hence will not deteriorate with age, and it is specially applicable for armature and field magnet wrapping.

A SENSATION IN INCANDESCENT LAMPS.—The Star Electric Lamp Company has now on public exhibition on Michigan avenue, Chicago, Ill., three incandescent lamps that are creating quite a sensation in electrical circles. In appearance they are ordinary 16-c. p. lamps, but it is claimed that by actual measurement one of them gave 720 effective candle power, another 184, and the other 160. The light is perfectly white and steady while the filament seems scarcely larger than in the ordinary lamp. The lamps were connected directly to the Edison mains and the instruments showed that the lamps were burned at 111 volts. The amperes averaged, it is claimed by those present, one-eighth ampere per lamp. Inventor John Kammer stated that these unusual results were obtained by introducing into the bulb a peculiar vapor which he recently discovered. The difference in illuminating power is determined by the quantity of vapor in the bulb. Mr. Kammer's efforts are now being directed to perfecting a one-watt lamp, and from the results already secured with his vapor treatment he expects to place such a lamp on the market in a very short time.

ORHGON CITY, Dec. 23, 1893.

POLE TAX.—It has been proposed to place a tax of $4 per annum upon each electric pole in Portland, Ore.

THE OAKLAND, CAL., City Council is considering an ordinance which has been introduced providing for an annual tax of $5 upon each telegraph and telephone pole in that city.

THE PORTLAND GENERAL ELECTRIC CO.'S new street lighting circuits are now in operation in the Woodstock, Waverly and Kenilworth districts, Portland, Ore. The company has resumed work upon its new breakwater on the East Side, in Oregon City.

THE CITY COUNCIL of Oregon City, Ore., is expecting to pass an ordinance, which has been introduced, for providing for charging all street railway companies operating freight cars on the streets, a license of $300 a year. The East Side Railway Co. is doing a profitable business in hauling freight in electric cars, discharging it at the front doors of the stores.

THE WATERLOO DITCH AND POWER CO., of Waterloo, Linn Co., Ore., has been incorporated with a capital stock of $6,000. The incorporators are: R. R. Humphrey, O. Jennings, George Medley, J. B. Wirt, A. G. McKee, and I. M. Knifong. Among the objects of the company are: The building and maintaining of an electric railway, telegraph and telephone lines, etc., between Waterloo and Albany, Ore. Also to operate a general electrical plant.

Canadian Notes.

OTTAWA, Dec. 30, 1893.

THREE RIVERS, QUE.—The latest phase in the electric light imbroglio is that the Royal Electric Company notified the Corporation of Three Rivers that they will shut down the lighting station on Jan. 15.

HAMILTON, ONT.—A contract has been awarded Loomer & Rose, Montreal, for steel rails for the Hamilton and Grimsby Electric Railway. The order was for 1,350 tons of rails, 1,200 tons of which are to be "T" rails and the balance girder rails. The rails were bought at less than one cent per pound.

VANCOUVER.—Notice is given that application will be made to the Legislative Assembly of British Columbia, at its next session, for an act to incorporate a company for the purpose of acquiring all property, both real and personal, tolls, rights, privileges and franchises of the Vancouver Electric Railway and Light Company, with power to purchase or lease the property and franchises of and amalgamate with any other railway or lighting companies.

English Notes.

(From our own Correspondent.)

LONDON, Dec. 20, 1893.

SECONDARY BATTERIES.—One of the many interesting points brought out in the papers read by Prof. Ayrton before the Institution of Electrical Engineers in 1890, and by Prof. H. E. Armstrong and Mr. G. H. Robertson in a paper read before the Royal Society in the following year, was the injury done to secondary batteries by leaving them for any length of time at rest. Sir David Salomons, whose book on the subject of accumulators was the first of its kind, now states that as a result of leaving some cells discharged for four years on a shelf that the plates are as good as ever, excepting that their color is bad. The charging of the plates after this long rest was done slowly and the surface scale was previously removed by a brush.

THE ELECTRIC LIGHTING OF EDINBURGH.—In his latest report to the Town Council of Edinburgh, Prof. A. B. W. Kennedy proposes a scheme which presents one or two novel points. His idea is to supply both North and South Edinburgh from one central station, but since the former is a compact business district, and the latter a particularly scattered residential area, Prof. Kennedy recommends that the three-wire system should be used in one case and the alternate current transformer system with transformers in the houses in the other case; both plants being housed under the same roof. For street lighting he recommends, since alternators will be available, at the station, the use of alternate current arcs fitted with a device now being tested by Mr. Ferranti for connecting the alternate currents.

BREAKDOWNS AT DEPTFORD.—The Deptford station was visited last week by a series of small misfortunes which by their concurrence resulted in the supply being partially interrupted for three days; the whole of the incident being typical of the danger of having a few large units. At the commencement of the week one of the two 1,750-h. p. sets was shut down in order that the machine might be altered so as to give 2,400 instead of 10,000 volts. The other 1,750-h. p. set was out of the running owing to damage to the spindle of the Corliss valve. Then one of the 750-h. p. sets was put out of action by something falling in the armature. This was followed by the governor of one of the 350-h. p. sets going wrong. Central stations, however, which have a number of small units capable of running in parallel, are not entirely exempt from breakdown. The week before last the Bankside station of the City of London Electric Lighting Co. was temporarily hors de combat. Some one accidentally broke the field circuit of a Mordey alternator, the armature of which thereupon short circuited the whole of the station with the result that every fuse went.

INSTITUTION OF ELECTRICAL ENGINEERS.—There have been periodical complaints from the telephone and submarine telegraph interests that their representation on the Council of the Institution of Electrical Engineers is totally inadequate. Some four years ago in answer to an agitation, several gentlemen, representing the telephone and submarine telegraph interests, were elected members of the Council, but as they neither attended the meetings of the Council nor offered themselves for re-election, they did not exert any appreciable influence on the affairs of the Institution and have now, like the "dodo," become extinct. A second agitation is now on foot. It is true that the telephone and submarine telegraph interests constitute a large proportion of the total members of the Institution, but as telephone and submarine telegraph men rarely, if ever, read papers, contribute to the discussion, or attend meetings of the Institution, it is scarcely right that they should be largely represented on the Council. There is some talk of forming a separate society, devoted to telephony and telegraphy. Although it is much to be desired that the Institution should embrace the whole of the electrical profession, I do not think that this threatened secession would materially affect the activity of this Institution.

News of the Week.

Electric Light and Power.

GENESEO, N. Y., has voted for electric lights.

KENTLAND, IND., is to have the electric light.

PEGGOTT, ARK., is to have an electric lighting plant.

SCOTLAND, DAK., is contemplating putting in an electric light plant.

SANDY LAKE, PA., will, it is said, soon be lighted by electricity.

BEVERLY, MASS.—A municipal lighting plant is being discussed.

SPIRIT LAKE, IOWA, will soon have an electric light plant in operation.

WINONA, MINN.—Bids are called for lighting the city, to be opened Feb. 11.

FAYETTE, MO.—The municipal plant is said to make a profit of $60 per month.

GRAND RAPIDS, MICH.—Alderman Emmer favors a municipal lighting plant.

WADSWORTH, NEV.—Peter Evans, of Reno, proposes to put in an electric light plant.

RIPLEY, TENN.—An electric light plant will be established by the authorities at Ripley.

MILWAUKEE, WIS.—Mayor Koch favors the city owning its own electric lighting plant.

SPRINGFIELD, MASS.—The street lighting committee has reported against a municipal plant.

YATES CITY, ILL., will issue $8,000 bonds and put in an electric light plant with the money,

PICKENS, W. VA.—The Pickens Electric Company is in the market for an electric lighting plant.

ABERDEEN, SO. DAK.—The County Board contemplate putting electric lights into the Court House.

ALLIANCE, O.—Business men are seriously considering the question of a new electric light plant.

UNION, O.—There is an active movement looking toward the formation of a new electric light company.

BEAVER, PA.—Architect Boyd, of Pittsburgh, has recommended that electric lights be placed in the Court House.

ARCHOBALD, PA.—The Crescent Electric Light Company, of Archobald, is preparing to extend the scope of its work.

KEYSER, W. VA.—Messrs. Henry G. and T. B. Davis will, it is reported, put in an electric light plant in the spring.

ASTORIA, ILL.—Editor Jones and Charles Foote, from Ipava, have made a proposition to establish an electric light plant..

PLAQUEMINE, LA.—At the January meeting of the City Council the question of an electric light plant will be considered.

ARCHBALD, PA.—The Raymond Coal Company is erecting poles along Main street for the purpose of running electric light wires.

CASTLETON, N. Y.—A special election of taxpayers has been called in the matter of voting for an appropriation for electric lighting.

WINFIELD, KAN.—G. P. Tomlinson and L. F. Duggan, of the Neosho, Mo., Electric Supply Company, propose to install a lighting plant here.

OGDEN, UTAH.—A franchise has been granted to the Pioneer Electric Power Company for lighting, heating, manufacturing and other purposes.

CANANDAIGUA, N. Y.—The Canandaigua Electric Light Company has extended its poles to Shortsville, and will light up that promising village.

GALVESTON, TEX.—The city authorities will inquire into the advisability of the city owning its own waterworks and electric light plant.

EL RENO, O. T.—An electric lighting franchise has been granted to the El Reno Heat, Light and Power Company, the plant to be completed in four months.

JAMESTOWN, N. Y.—A committee has been appointed to investigate the municipal plant, run by the son of an alderman. Gross frauds are charged.

PATERSON, N. J.—Mr. John F. Noonan opposes a municipal plant and says that a 600-light plant would cost $560,000 and deteriorate 30 per cent. a year!

CHICAGO, ILL.—Through the persistent efforts of City Electrician Barrett, the Council has passed an ordinance for the extension of the municipal electric light plant.

SHORTSVILLE, N. Y.—The Canandaigua Electric Light Company have extended their poles to Shortsville and will light up that promising litle manufacturing village.

NEW WHATCOM, WASH.—A new company has applied for an electric light franchise, the intention being to utilize the water power of Whatcom Creek, which is rated at 20,000 h. p.

LITTLE FALLS, N. Y.—The Litle Falls Electric Light and Power Company has bought one of the prize dynamos exhibited at the World's Fair, to be used on the commercial arc circuit.

MILFORD, MASS.—All the electric light property in Milford has been bought by the Milford Electric Light Company, and improvements and extensions will be made. Stanhope T. Nelley, of Milford, is manager.

ST. CHARLES, MO.—The City Council has been petitioned by four different companies to grant them a franchise for an electric light plant. Troy, Mo., says it would be glad to see one of the companies come up its way.

HARTFORD, CONN.—President Dunham, of the Hartford Electric Light Company, has informed the city authorities that the new incandescent arc lamp was proving very satisfactory, and that it was the intention to replace all of the street lamps with these.

MERIDEN, CONN.—The following have been appointed a committee to look into the matter of an electric lighting plant for the city and to investigate the light now being furnished by the local company: Amos Ives, T. M. Crowley, Eugene Blake and H. T. King.

BUCKSPORT, ME.—The canvas in the matter of electric lighting for Bucksport is meeting with much success, and it is almost certain that Charles Maxfield, of the Fairfield (Me.) Electric Light Company, will carry on and enlarge the business of the former local company.

NIAGARA FALLS, N. Y.—The result of the many complaints against the Buffalo and Niagara Falls Electric Light and Power Company, has been that the Board of Public Works is authorized to ascertain the cost of an electric lighting plant, to be built and operated by the city.

PRAIRIE DU CHIEN, IOWA.—The City Council has passed an ordinance granting the Prairie City Electric Company an exclusive franchise for ten years, for constructing and maintaining an electric light and power plant in that city. The ordinance is void if the company fails to have its plant in operation six months from date.

ELK POINT, DAK.—William Dupont, by his attorney, Ira L. Nichols, appeared before the City Council at its last regular session and made the proposition that if the city would grant him the franchise and guarantee him a certain amount of patronage, he would place an electric light plant and system of waterworks in the city. The citizens look upon the proposition favorably, and work will probably be begun upon the improvements in the early spring.

BELLEFONTAINE, OHIO.—Robert Colton has proposed, in consideration of a franchise for electric lighting and a street railway, to furnish not less than eighty 2,000-c. p. arc lights, all night, for $88 per annum. The privilege to be granted for ten years, the town to have the right to purchase the electric light plant at the end of any year, at a price to be fixed by a committee or at 10 per cent. advance on its cost.

THE KEESVILLE, N. Y., Electric Light Co. has sold its plant at Keesville to Morse Bros., formerly of the Electric Construction Co., of Greenwich, N. Y., and more lately of the Consolidated Electric Co., of Greenwich, N. Y. The Morse Bros. have considerable property in Greenwich which was given in exchange part payment of the plant. The owners of the Keesville Electric Co. have been very anxious to dispose of their property in order to invest in the electric railroad, which has been surveyed from Greenwich to Schuylerville, and a local manufacturer has been induced to construct a dam in exchange for the property mentioned above.

The Electric Railway.

ATTLEBORO, MASS.—A receiver has been appointed for the Inter-state Electric Railway system.

BERLIN, ONT., CANADA.—Incorporation is being asked for a company which proposes to build an electric road between Berlin and Preston.

DANVILLE, ME.—Ricker Brothers, of Danville, are receiving estimates for their proposed electric road from Danville Junction to Poland Spring House.

ITHACA, N. Y.—The Ithaca Street Railroad Company has filed certificate of increase of capital stock from $175,000 to $250,000.

LOCKPORT, N. Y.—E. M. Ashley, of the Lockport Street Railway, says that the road to Olcott, 12 miles long, will be built during the coming summer.

FALL RIVER, MASS.—The plan proposed some time ago for building an electric railroad between this city and Stone Bridge, Tiverton, is in a fair way to be realized.

PETERSBURG, PA.—A preliminary survey is now being made by Major W. J. Gordon, of Fredericksburg, Va., for the Atlantic Coast Line for a belt line around Petersburg.

POTTSTOWN, PA.—The line of the Ringing Rocks Electric Railway Company is being located. The length of the road will be 3¾ miles with a maximum grade of 5 per cent.

FROM LOWELL (MASS.) TO THE SEA.—It is proposed to construct a State highway from Lowell to Newburyport, the plan of which includes a way for an electric railroad.

HARTFORD, CONN.—President Dunham, of the Hartford Electric Light Company, informed the city authorities that a storage battery street railway service would be in operation within six weeks.

GOSHEN, N. Y.—Secretary Wightman, of the Middletown-Goshen Traction Company, states that the company is prepared to build the line as soon as franchise is granted by the Board of Trustees.

WHITINSVILLE, MASS.—The Selectmen of Northbridge, Mass., will meet in the matter of granting a franchise to the Whitin Machine Works, to build and operate a private electric line from Whitins village to Northbridge, about 1½ miles.

MILWAUKEE, WIS.—The Peterson Electric Railway System has been on exhibition. A model car has been running back and forth over a track, an automatic reversing arrangement reversing at each end of the track.

BOONSBORO, MD.—The officers of the electric railway company have decided to erect the power house in Boonsboro, and land has been bought and laid out on North Main street. Contractor Mosher has the building contract. There is talk of extending the road to Smithsburg.

PHILADELPHIA, PA.—The decision of the Dauphin County Court has put new life into the North Eastern and Quaker City Elevated roads, and President Bucholz states that work will be pushed as soon as the temporary injunctions issued by the courts of Philadelphia can be removed.

JERSEY CITY, N. J.—The Jersey City "Journal" is responsible for the statement that the Jersey City, Hoboken and Rutherford Electric Railroad Company is to have an elevated track from the top of the Palasades to a space adjoining the property of the Hamburg Steamship Line in Hoboken, to cost at least $750,000.

EXETER, N. H.—At a meeting of the Exeter Street Railway Company, held at the office of Hon. E.G. Eastman, at Exeter, N.H., Simon W. Hathaway, of Boston, presented an offer of a Boston syndicate, which proposes to purchase and extend the road. It was decided to lay the mater over for a few days.

FALL RIVER, MASS.—A company has been formed here to build an electrical railway from Fall River to Stone Bridge, Tiverton, and the Globe Street Railway Company is behind the scheme. The president of the new company is Daniel T. Church of Tiverton; Weaver Osborn and George W. Slade, of Fall River, are interested parties.

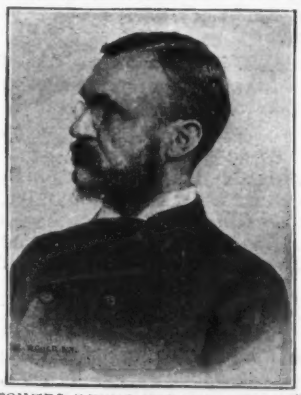
BATTLE CREEK, MICH.—Edward C. Hinman has been appointed receiver of the Battle Creek Electric Railway. He has not yet been put in possession of the road, but he has stated his policy, which is to put the road in running order as soon as possible. The experts who were employed to make estimates as to cost of remodelling the road, have not yet filed their report.

MIDDLETOWN, CONN.—The Middletown Electric Road Company will equip with electricity and extend its tracks next spring to Meriden and neighboring suburban villages. When the bridge to Portland is constructed the tracks will be laid across to Portland up along the river meeting the Glastonbury road. Hence another winter will see a net work of electric roads connecting Hartford, New Britain, Meriden, Middletown, Portland and Glastonbury. A summer resort will be established at Black Pond, which lies just about half way between this city and Meriden.

THE UNION RAILROAD COMPANY, of New York, has filed with the Secretary of State a statement of its proposed extensions, which contemplate a system of intercommunication in the upper part of New York City. The proposed extensions are as follows: From Third avenue to Eighth avenue; on Madison avenue from the bridge to One Hundred and Thirtieth street; on One Hundred and Thirtieth street from Madison avenue to Eighth avenue; over the bridge across the Harlem River from Third avenue to Second avenue, and along Second avenue to One Hundred and Twenty-fifth street; along Fourth avenue to One Hundred and Twentieth street to Madison avenue, and from Washington Bridge to Boscobel avenue and along that avenue to Jerome avenue; along Broadway to the city line.

Personal Notes.

MR. CHARLES A. SCHIEREN, who was elected Mayor of Brooklyn last November by such an overwhelming majority, was installed in office with appropriate ceremonies on the first day of of January. The expectations of those who cast their ballots for Mr.Schieren have been abundantly met by the excellent appointments he has thus far announced, although naturally many of them have not met with the approbation of professional politicians. With the assurance given by these appointments, that Mr. Schieren means to carry out the promises upon which he was elected, and with the admirable business qualifications which have brought about his great success in commercial life, the citizens of Brooklyn may congratulate themselves upon the prospect of an able and upright administration, like that enjoyed under Mayor Low.



MR. WILLIAM J. HAMMER and Miss Alice Maud White, of Cleveland, Ohio, were married in that city, on Wednesday, Jan. 3. Mr. Hammer's name has long been a familiar one in electrical circles and his many friends will join us in extending to him our heartiest congratulations.

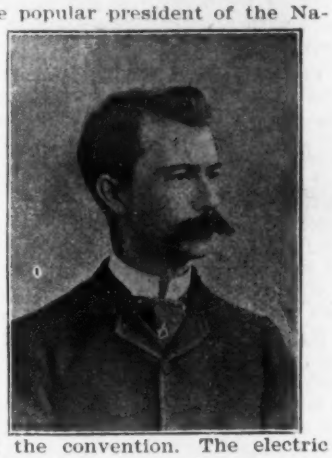
MR. HORATIO A. FOSTER was married at Chicago, on Dec. 22, to Miss Florence Louise Root, of Keokuk, Iowa, After the ceremony the happy couple left for New York, where they will make their home. Mr. Foster is well-known in the electrical field and has the congratulations and best wishes of his many friends.

MR. GEORGE H. BABCOCK died on Dec. 16, less than three weeks after the burial of Mr. Stephen Wilcox, his partner in the world-wide known firm of Babcock & Wilcox, manufacturers of boilers. The close personal association of these gentlemen, aside from purely business matters, was well known and it seems almost more than a coincidence that they should have thus passed out of the world so closely together.

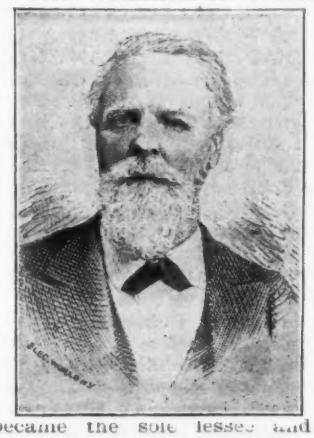
WILLIAM HERBERT PARKER died in England, December 18, after a lingering illness. Mr. Parker was educated at Bradford College and afterward took a technical electrical course at the Hanover Square School of Electrical Engineering. He was at one time on the editorial staff of the London "Electrical Engineer."

MR. FREDERICK BATHURST, on Dec. 16, suffered a sad afflicted in the death of his father in England, to whose bedside he had been called from America.

JUDGE E. A. ARMSTRONG, the popular president of the National Electric Light Association, is looking forward to a most interesting session of that organization at the next annual meeting, which is so soon to take place at Washington, D. C. The National Capital was happily chosen for the gathering of the clans, and the social features of the occasion will no doubt play a more prominent part than usual. The wide personal acquaintance of Judge Armstrong among those identified with the electric lighting interests and his well-known energy and his peculiar fitness for the position he holds render it certain that everything will be done which can contribute to the success of the convention. The electric lighting field is sure to prove an interesting one during the coming year in view of the expiration of the Edison lamp patent.



MR. WILLIAM RICHARDSON, for many years president of the Atlantic Avenue Street Railroad, Brooklyn, died at his residence, 125 South Oxford street, Brooklyn, on Dec. 31, aged 72 years. Mr. Richardson came to America from England when 12 years old, and was engaged in the newspaper business in various capacities, from an early age up to the outbreak of the Civil War, when he was appointed a paymaster in the United States army. Four years later he became superintendent of the Dry Dock, East Broadway and Battery Railroad Company, from which position he quickly passed to director and president of the road. In 1867, Mr. Richardson became the sole lessee and proprietor of the Brooklyn and Jamaica Railroad Company, and afterwards built up the Atlantic avenue system, with which his name was strongly identified up to about a year ago, when the various roads included in it were sold to the Brooklyn Traction syndicate. Mr. Richardson served as clerk to the New York State Assembly previous to the war, and also temporarily as Speaker, and was an Alderman in Brooklyn from 1870 to 1872. He was always prominently identified with the temperance movement, and from his devotion to the interests of the Baptist Church, was familiarly referred to as "Deacon" Richardson by newspapers, in which he at times figured largely on account of his determined fights against the elevated railroad and other interests opposed to his own.



Miscellaneous Notes.

STREET MAIL CARS.—Postmaster-General Bissell recommends the employment of electric street mail cars in cities.

AT THE DECEMBER MEETING of the directors of the Massachusetts Institute of Technology, the reports showed that the largest number of students are following the course of electrical engineering during this year. Mechanical and civil engineering and architecture follow in the order named. The total number of students is now 1,158.

THE FRANKLIN ELECTRICAL SOCIETY will, on Jan. 6, give a banquet in commemoration of Benjamin Franklin at "The Columbia," Union square, New York. The committee in charge are Messrs. A. A. Hammerschlag, Newton Harrison, Louis Wasself, Max Meyer, and Ernest V. Lallier. Mr. Wallace W. Ker will officiate as toastmaster, and the following gentlemen will respond to the toasts: Mr. Newton Harrison, "Benjamin Franklin"; Mr. E. V. Lallier, "Electrical Terms and Phrases"; Mr. Max Meyer, "The Ladies"; Mr. A. A. Hammerschlag, "The Franklin Electrical Society."

ELECTRICITY IN NAVY YARDS.—A board has been selected to inquire into the advisability of operating all electrical appliances at the New York and Norfolk Navy Yards. The Navy Department believes that this can be done, and that it will result in an economy of money and power. The board selected will meet at the Brooklyn yard at once. It consists of Commander Washburn Maynard, Lieutenant J. D. Murdoch, and Prof. O. G. Dodge. The latter is an expert electrician, who has been on duty at Chicago.

SCORING BY ELECTRICITY.—At the bicycle tournament in the Madison Square Garden, the chief electrician of the Garden,

Mr. Frank Martin, arranged a system for scoring by means of incandescent lamps. On each of a number of perpendicular poles ten incandescent lamps are suspended; when a rider makes a lap his scorer hangs a loop and the first light blazes up; so on each lap until the ten lamps are lighted, when they are extinguished by taking off the loops and the rider is credited with a mile with placards. As a check, there is another scorer recording each contestant's laps in the regular book.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION has issued a circular, which will be sent to fellows of the Association, to members of the medical profession, to electrical experts and to manufacturers of electrical appliances for medical work, containing titles of all the committees, the members serving on them with their addresses and the matter prepared for discusion and investigation by each committee. Manufacturers are asked to submit instruments for examination, and physicians, electrical experts and manufacturers are requested to co-operate in making suggestions and in relating their experience and preference for instruments, with reason and data. The circular gives full details as to points to be considered.

ELECTRIC WATER SUPPLY RECORDS.—City Engineer Jackson, of Boston, recommends the connection of the city water service pipes with the central office by electrical means, in such a way that the water department superintendent may be informed by a glance at automatic records the pressure in the mains in various parts of the city, and the state of the numerous valves, whether open or shut. By this means a break in the mains would become at once apparent, and a check would be had in regard to work on cut-out pipes. It was also recommended to show by the same means, in the central office, the height of water in the reservoirs.

THE SYRACUSE (N. Y.) STORAGE BATTERY COMPANY has a street car propelled by storage batteries running at Oneida. The total run on one charge of the batteries was 125 miles. The car makes daily from 64 to 90 miles without a break in the service. The 125 miles run was made on a seven hour charge. There are 96 cells used in the car. The motor is a single 30-h. p. Rae type, with truck made by the McGuire Company, of Chicago. The motor and truck were purchased of the Detroit Electrical Company. The motor is wound for 190 volts. The voltage of the 96 cells at the start of the 117 mile trip was 204; at the end 192 volts, a loss of only 12 volts in a day's trip. The car is lighted from a bank of 24 cells with 48 volt incandescent lamps.

AN ELECTRICAL FOUNTAIN.—The Bubier Publishing Company, of Lynn, Mass., displays a miniature electric fountain in its show window, designed by E. T. Bubier. Incandescent lamps are arranged in a parabolic reflection situated in the bottom of a tubular receptacle of zinc which is about three feet high and some twenty inches in diameter. The lamps are incandescent and the bulbs are of six different colors, two shades of red, two of green, and one each of blue and green. Above the reflection is a screen of uncolored glass fitting into the scenic receptacle so as to be water tight, and an ingenious arangement of valves allows the water which is projected some three feet in height to be diversified in the shape and number of the jets, while by means of the switches that control the lights, the colors can be so changed as to afford considerable variety of shade.

CANAL NAVIGATION.—M. De Puy, in a letter to the New York "Tribune," says that with steam power canalboats it costs only a fraction over a quarter of a mill per ton per mile to move freight He is sceptical of any increase of speed with the present depth of water in the Erie Canal, and says that steamers often tow canal boats so fast that they strike the bottom of the canal. Referring to the advantages of steam canalboats he says that "The present rate for towing a boat load of grain from West Troy by towing companies to New York is $28, or $112 for four boats, while a steam canalboat brings its three consorts down the river at one-quarter of the latter sum, making a saving of $84 on each down trip. Still another highly important point in favor of steam power is that it is independent in the harbors of New York and Buffalo, while trolley boats must look for tugs to tow them.

THE ELECTRICAL WORKERS' UNIVERSITY EXTENSION SOCIETY has been formed under the auspices of Columbia College. A course of ten lectures has been arranged to take place in the large hall of Cooper Union, and President Seth Low, of Columbia College, has agreed to contribute $1,000 for the expenses of the course, provided no admission fee is charged. Members of the society will be charged $2 for the whole course and outsiders will have to pay 25 cents admission to each lecture. After the first lecture a free class will be formed, taught by W. H. Freedman, tutor of electrical engineering in Columbia College. The course is as follows: 1. Batteries, Primary, Secondary and Thermo, by C. O. Mailloux; 2. Dynamos and Motors, Direct Current, by S. S. Wheeler; 3. Alternating Dynamos and Motors, by W. F. Stanley; 4. Electrical Measurements, by A. E. Kennelly; 5. Lighting, by Prof. F. B. Crocker; 6. Power, by Nikola Tesla; 7. Street Railways, by T. C. Martin; 8. Telegraphy, by William Maver, Jr.; 9. Electrical Alarms, by William Maver, Jr.; 10. Telephones, by J. J. Carty. The officers of the society are: M. J. O'Connor, president; William Ivory, vice-president; C. H. Hines, secretary; A. J. Kelly, treasurer, and F. E. Alexander, librarian.

A NEW TELEPHONE.—A telephone company that is to be a rival of the Bell monopoly was incorporated at Madison, Wis., with a capital stock of $500,000, by A. B. Ferdinand, H. C. Dodge, and Edward W. Spencer, of Milwaukee. The name of the new concern is the Northwestern Telephone and Electric Company. It will not begin operations until after Jan. 30, when the last of the Bell Company's patents will expire. The company will not duplicate the Bell instrument. The incorporators say their telephone possesses great advantages over the ones now in use, and claim it gives a clearer and more distinct transmission. Among the improvements is an automatic switch arrangement which makes it possible for a half-dozen subscribers to use the same line, which, by an automatic arrangement, will prevent all the other subscribers on the line from talking or from hearing the conversation going on. It is the object of the company to manufacture telephones and establish telephone exchanges. The office, headquarters and factory of the company will be in Milwaukee. A few of the telephones are now being made, with the exception of those parts upon which the patents have not expired. They are being made up piecemeal. The company has taken no steps toward procuring a factory where the instruments and supplies will be made. The Northwestern Company is the first company in the field, besides the Bell companies, to be incorporated, though there is at present a company being organized in Chicago to operate upon much the same plan as the Northwestern Company.

Trade and Industrial Notes.

THE NATIONAL THERMOGRAPH AND ELECTRICAL COMPANY, of Chicago, is now located in Rockford, and the company expect to give employment to 500 men.

THE RAILWAY EQUIPMENT COMPANY, 81 East Front street, Cincinnati, Ohio, is presenting its friends and patrons a handsome bronze paper-weight in the form of a trolley car.

THE PETTINGELL-ANDREWS COMPANY, 192-202 Summer street, Boston, has issued a handsome and convenient calendar which it is sending out to its friends and patrons.

THE NEW CASTLE (DEL.) STREET CAR WORKS, one of the largest and best equipped plants in the United States, was almost destroyed by fire on Dec. 22. The loss is $12,000, partially covered by insurance.

THE WHEELER CONDENSER AND ENGINEERING COMPANY, 39 and 41 Cortlandt street, New York, has recently made many new and important improvements at its works, Cartaret, N. J. Its surface and admiralty condensers are so favorably known that comment is unnecessary.

THE GENERAL ELECTRIC COMPANY'S repair shops at Atlanta, Ga., are to be closed. Mr. Fred Miles, who has been in charge of these shops, is to open a repair shop of his own in Atlanta, under the name of The Southern Electric Works, for the repair of all kinds of electric apparatus.

HUEBEL & MANGER, 289 Graham street, Brooklyn, have issued a handsome catalogue of bells, push buttons and other electrical goods manufactured by them which dealers in house goods will do well to send for. The articles are principally of standard form, but notable improvements in details have been introduced.

J. W. PENFIELD & SON, Willoughby, Ohio, have issued an 80-page catalogue of imperial friction clutches, cut-off couplings, iron and wood pulleys, and pulley and shafting fittings. Those interested will find considerable technical matter of value, as well as detailed descriptions of the well-known transmission devices of this company.

THE MECHANICS' GENERAL MANUFACTURING COMPANY of St. Paul has filed articles of incorporation. The capital stock is $10,000,000, and the business is the manufacturing of electric motors hardware and aluminium wares, novelties, machinery, tools, etc. The incorporators are Darwin H. Kent, Paul and A. A. Price, F. M. Johnson, P. L. Uttley and C. J. Backus of St. Paul.

QUEEN & CO., Philadelphia, have a very excellent portable tachometer by means of which the speed of engines, dynamos and motors, can be quickly and accurately determined. It is compact, convenient to handle and will indicate revolutions up to 3,000 turns per minute. They also have stationary types for permanent attachment. In the economical operation of a lighting or power plant it is highly necessary to run a dynamo very close to schedule speed, which can only be determined by an instrument such as the above.

THE BALL ENGINE COMPANY, Erie, Pa., through its late Eastern agent, F. R. Chinnock, has sold the following engines during the past few months: J. M. Iver Co., Danbury, Conn., one engine; Ridgewood Electric Light and Power Co., Ridgewood, N. J., one boiler; Brooklyn Navy Yard, one 100-h. p. heavy duty engine, for running saw mill; General Electric Co., for Hot Springs, Va., increase, two engines, one boiler; Imperial Hotel, New York City, one 150-h. p. engine; Messrs. Schwarzenbach, Huber & Co., Union Hill, N. J., one boiler; for export to Cuba, three engines; Big Four R. R. Co., Indianapolis, Ind., complete steam plant, including two engines and three boilers; John Good Rope, Cordage and Ma-

chine Co., Ravenswood, L. I., one 600-h. p. cross-compound engine.

MR. F. R. CHINNOCK, who for the past two years has been the general Eastern agent of the Ball Engine Co., of Erie, Pa., has resigned his agency of that company, and will again enter the electrical field, in which industry he was so long and successfully identified. While Mr. Chinnock has been very successful as the agent of the above company, he feels that he will be still more successful in the larger and broader field of electricity, in which line he met with such flattering success as the agent of the Edison General Electric Co., with whom his many friends will remember he was associated for eight years.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 36 Cortlandt street, this city, has increased its capital stock from $20,000 to $250,000. The stock of this corporation is held entirely by its officers and employees. This company has been very succesful in its patented specialties, and especially with its Mesco dry battery, which is having a large sale. Over 20,000 of these dry batteries were sold during the year 1893 to telephone companies for use on long distance telephone transmitters; the batteries are holding out remarkably well for this service, and were adopted only after a long and careful test.

THE E. P. GLEASON MANUFACTURING COMPANY, 181 to 189 Mercer street, New York, is now preparing a distinct novelty in its standard reflector pendants for electric illumination. For some time it has made a number of different patterns in this line of manufacture, for from two to eight lights in a cluster, with a white porcelain stack, to reflect the light; these have been very successfully introduced and recently the new building of Brokaw Bros. was completely equipped with them. The new style is simply a difference in the porcelain reflector, which is covered with quicksilver and the under surface corrugated, so as to better diffuse the light.

THE ADAMS ELECTRIC COMPANY has been recently formed at Worcester, Mass., for the manufacture of Mr. A. D. Adams' line of improved dynamos and motors, which new machines will be of the same general type of his former ones, and embody his well-known forged iron field magnet construction, and several other improvements. In view of the fact that armature burn-outs are due to the destructive action of heat on the cloth and paper usually employed to insulate armature cores from their windings, it has been decided to use a fireproof material for the insulation of all armature cores in the new machines. This construction is a distinct advance on the present state of the art. The line of dynamos and motors manufactured at present will cover the usual sizes from 1 to 20 kw., and shipment of any of these can be made during January. A large well-lighted shop has been fitted up at 100 Beacon street, Worcester, for the manufacture of the above machines, and the company already have several orders in hand.

THE HUBLEY MANUFACTURING COMPANY, Lancaster, Pa., has elected as president Henry Baumgardner; treasurer, D. B. Shenk, and seven directors, as follows: Henry Baumgardner, John E. Hubley, F. H. Stacy, N. M. Woods, Geo. N. Reynolds, Dr. M. L. Herr and D. B. Shenk. The capital stock was fixed at $200,000, and the charter was directed to be applied for at once. The company will take up the patents, inventions and designs of the business carried on for the past several years by John E. Hubley and Henry Baumgardner, at Duke and Vine streets, the business having outgrown its original limits and warranting a very considerable extension. In the new plant on the Pennsylvania Railroad, on the extension of Shippen street, the new company will manufacture a large line of electric, steam and mechanical toys, indestructible malleable iron and steel toys, cast-iron toys, electric motors, electric apparatus; also, specialties in cabinet, stationer's and staple hardware, and a complete list of novelties of original designs for the toy, stationer's and hardware trade.

Business Notice.

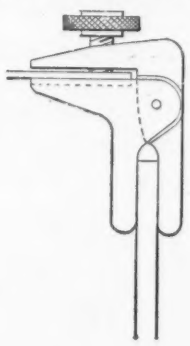
BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

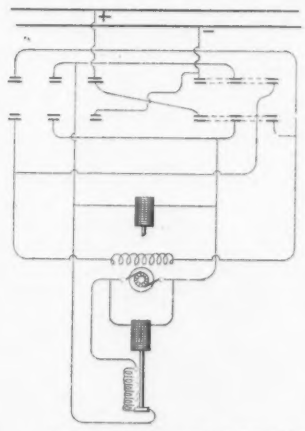
U. S. PATENTS ISSUED DEC. 19, 1893.

510,889. TEMPERATURE REGULATOR FOR ELECTRIC HEATERS; A. M. Butz, Oak Park, Ill. Application filed Dec. 24, 1892. The combination with the resistances and their circuits of the corresponding mercury cells and a compound rheostat having graduated pins adapted to dip into the cells and complete the circuits successively.

510,892. BRUSH HOLDER; J. R. Coffman, Detroit, Mich. Application filed Dec. 9, 1892. In a brush holder for dynamos and motors the combination of a support or frame, a carriage movable therein, a loose shaft mounted in the support, a coiled spring connected with the loose shaft and carriage means for rotating the loose shaft to adjust the tension of the spring and means for locking the shaft in its adjusted position.



NO. 510,898.—ELECTRICAL CONNECTOR.



NO. 510,932.—ELECTRIC ELEVATOR.

510,898. ELECTRICAL CONNECTORS; F. G. Curtis, New York. Application filed Feb. 13, 1893. An electrical connector consisting of two jaws of conducting material, pivoted together at a point intermediate of their own length, one of the jaws carrying a binding screw at one of its ends adapted to bear against the conductor supported by the corresponding end of the other jaw, and the opposite ends of the jaws constituting a clamp. (See illustration.)

510,921. ELECTRIC PUMP; F. W. Merritt, Duluth, Minn. Application filed Dec. 2, 1892. The combination with a pump and electric motor connected therewith of a controlling device comprising a cylinder connected with the compressed air cylinder of a pump, a piston arranged to work in the cylinder, and a circuit-maker and breaker connected with the piston and controlling the circuit between the generator and motor.

510,929. SYSTEM OF TELEGRAPHY; J. A. Parker, St. Louis, Mo. Application filed July 30, 1892. In a telegraph apparatus, a series of depression keys, a source of electrical energy composed of suitable subdivisions adapted to generate currents of variable intensity and polarity, conducting wires leading from these subdivisions and adapted to make electrical contact with each key of the series, a second series of conducting wires leading from the keys, a rotadrum adapted to conduct the respective currents from the second series of conducting wires, and a single line wire for communicating the impulses formed on the depression of the keys.

510,932. ELECTRIC ELEVATOR; F. A. Perret, Brooklyn, N. Y. Application filed Nov. 12, 1892. The combination of an electric motor and its circuit, an electric switch controlling the circuit, a locking device for the switch when in its "open" position, a rheostat in the motor circuit and an electro-responsive apparatus operating the rheostat and the locking device. (See illustration.)

510,947. ELECTRIC LOCOMOTIVE; C. F. Winkler, Troy, N. Y. Application filed March 11, 1893. An electric motor having two armatures included in a single field magnet circuit, two car axles respectively connected with the armatures and a field magnet divided into two parts, magnetically connected together, the joint being yielding and in a vertical plane. (See illustration.)

510,952. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINE; F. E. Averill, Syracuse, N. Y. Application filed Feb. 13, 1893. In a brush holder for dynamo-electric machines, the combination of a supporting spindle, a brush holder frame loosely mounted on the spindle and having one extremity adapted to support the brush, an arm fixedly mounted on the spindle and arranged between the two extremities of the holder frame, and a spring having one end connected to the arm and the other to the opposite extremity of the holder frame.

511,005. TELEGRAPHIC RELAY; Edward Weston, Newark, N.J. Application filed June 4, 1891. The combination in an electrical apparatus of a magnet, a coil rotary on a diametral axis in the field of force of the magnet, a pivot shaft supporting the coil and two springs, both applied to the shaft near one end.

511,017. ELECTRIC RAILWAY SWITCH AND CROSSING; W.W. Hendrix, Bowling Green, Ky. Application filed Aug. 5, 1892. In a switch or crossing, a sliding block, its upper part consisting of flanges, its lower part consisting of a cylinder and its front and rear ends consisting of connecting strips.

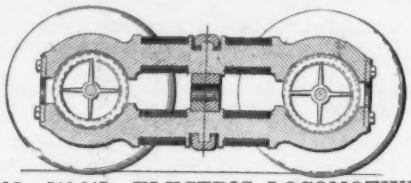
511,018. ELECTRIC RAILWAY TROLLEY; W. W. Hendrix, Bowling Green, Ky. Application filed Aug. 5, 1892. An attachment for electric railway trolleys consisting of two jaws hinged one on each side of the trolley, the upper ends of the jaws having their front edges beveled to the rear, the upper ends adapted to overlap over the wire, suitable springs connecting the jaws above their hinged point.

511,019. ELECTRIC RAILWAY TROLLEY; W. W. Hendrix, Bowling Green, Ky. Application filed Oct. 7, 1892. An overhead trolley having its lower end pivoted in a swiveled boot, the trolley-pole bearing against its under side one end of the coiled spring, the coils of the spring passing around the pivot and the other end of the spring bearing against the bottom of the boot.

511,049. ELECTRIC ARC LAMP; A. Hormel and G. S. Junginger, New York. Application filed March 24, 1893. In an electric arc lamp, a spirally grooved carbon rack in combination with the springs having pins projecting into the grooves of the rack, and set-screws pressing upon the springs and holding the pins in the groove of the rack.

511,081. TELAUTOGRAPH; R. M. Hunter, Philadelphia, Pa. Application filed May 26, 1893. The combination of a line circuit, a source or sources of positive and negative electricity, hand-controlled devices between the sources of electric energy and the line for causing an alternating variable potential current to flow over the line circuit, electro-magnetic devices at a distant place operated by the positive and negative impulses in the line, and common marking or tracing devices moved by the electro-magnetic devices operated by the alternating variable potential current of the line, and common marking or tracing devices operated by the electro-magnetic devices.

511,118. MAGNETO-TELEPHONE; J. A. Brown, Moline, Ill. Application filed Aug. 16, 1893. In a telephone, a magnet, a coil or



NO. 510,947.—ELECTRIC LOCOMOTIVE.

solenoid, and acute mounted for free horizontal movement in the direction of its length and having a coil and armatures at one end and a spring armature at the other end.

511,131. ELECTRIC RAILWAY SIGNAL; Jose Ortega y Espinosa, Mexico, Mexico. Application filed Oct. 26, 1891. Contact-making devices for a roadbed consisting of a set of curved longitudinal metal strips insulated from each other and provided with downward extensions and electro-magnets and armatures for connecting or separating these strips by the action of the electro-magnets.

511,157. HAND REGULATORS FOR ELECTRIC MOTORS; W. D. Packard, Warren, O. Application filed Dec. 8, 1892. In a rheostat, a frame extending across the face, a shaft mounted in the frame, a sweep-arm on the inner end of the shaft, and a spring-impelled balance wheel fast on the outer end of the shaft.

511,159. PRIMARY ELECTRIC BATTERY; E. Poppowitsch, Brooklyn, N. Y. Application filed Dec. 28, 1892. In an electric battery, a packing for separating the positive and negative plates composed of a mixture of saw-dust, sea-salt, salammoniac, bichromate of potash, mercury, granulated manganese and concentrated sulphuric acid.

511,163. SIGNAL FOR CABLE RAILWAYS; J. Sachs, New York. Application filed Aug. 4, 1893. The combination with a vehicle and a cable for moving same of signal boxes adjacent to the cable, an electric circuit connecting the signal boxes with the central station and devices that can be actuated from either end of the car for operating the signal boxes by the movement of the cable and car.

511,167. LABEL HOLDER; J. H. Shaffer and E. Horovsky, Allegheny, Pa. Application filed Dec. 21, 1892. The combination with a bolt or traveler of a tumbler engaging with the traveler and locking the same, the tumbler being formed of magnetizable material, and a magnet for withdrawing the tumbler from engagement with the traveler to release same.

511,172. TELEGRAPHIC TRANSMITTER; H. F. Stinde, Red Bud, Ill. Application filed May 4, 1893. The combination of exposed conductors, a series of fixed frames each having a yielding limit-stop near the conductors, a key rod guided in each frame, and a spring supported by the frame in the path of the key rod and with its free end adapted to impinge against the spring stop as it moves away from the exposed conductors.

511,173. ELECTRICALLY OPERATED RAILWAY SWITCH; C. A. Stone, Newton, and E. S. Webster, Boston, Mass. Application filed Aug. 30, 1892. In an electric railway system a pair of railway-switch magnets, each in an independent circuit from the main conductor, which circuits are respectively closed by a switching device which is automatically operated by a current different in intensity from that of the others, but all drawn through the trolley of a passing car.

511,187. ELECTRIC REGULATING SWITCH; E. A. Barber, Watertown, N. Y. Application filed June 26, 1893. In an electric switch operated directly by a solenoid acting on an iron core, the combination with the solenoid and the iron core of a piece of soft iron located at one end of the solenoid to act as a brake to prevent oscillation of the switch.

511,188. ELECTRIC SIGNALING DEVICE FOR HOSE; G. L. Barnard, Milwaukee, Wis. Application filed Aug. 22, 1892. The combination with a hose of electric circuit wires corrugated or repeatedly bent and arranged spirally within the wall of the hose, extending throughout the length of the hose, and suitable means for making electrical connections with the ends of the wires.

511,196. ELECTRIC MOTOR; O. F. Conklin, Dayton, O. Application filed July 5, 1893. In an electric motor, the combination with the stationary shaft of a combined brush holder and shaft coupling consisting of a part with laterally extending sockets, and brush holders adapted to be supported in the sockets.

511,214. BRUSH HOLDER FOR ELECTRIC MOTORS; J. J. Robison and Fred. B. Perkins, Toledo, O. Application filed Feb. 6, 1893. In a brush holder for electric motors, comprising in combination a bracket having a threaded portion, a shell for receiving the brush, and slotted, an arm at right angles to the bracket and provided with flanges at each side, a lever pivoted to the end of the arm and carrying a transverse bearing-bar at its free end, pins attached to the arm and lever, and a spiral spring attached to the pins whereby the lever is pressed against the brush within the holder.

511,229. ELECTRIC LAMP; A. Zobel, Munich, Germany. Application filed Feb. 15, 1893. In an electric glow-lamp the combination with a lamp socket of a pair of conducting wires extending through the lamp socket, a third conducting wire inserted in the socket and projecting into the lamp, a filament connecting the pair of conducting wires, a second filament connecting the second wire of the pair with the third wire, and a loose contact device within the lamp and arranged to connect the third wire with the second wire.

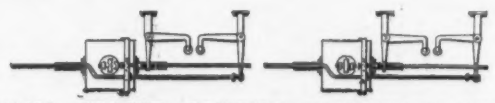
511,234. MORSE TRANSMITTER; A. F. M. Cornand, Brussels, Belgium. Application filed May 29, 1889. The combination with a series of key levers connected to one terminal of a circuit, and each provided with a projection having insulated spaces, of a vibrating frame, a metallic brush connected therewith, a lever connected to the frame, a bar extending below the key levers and connected to the lever, and a retracting spring.

511,240. ELECTRIC SWITCH; J. L. Hinds, Syracuse, N. Y. Application filed Nov. 27, 1891. In an electric switch, the combination of a base plate, a pair of terminals, a spring having one end engaged with one terminal and the other adapted to be brought into contact with the other terminal, a cam for engaging the extremity of the spring with the other terminal, and a shoulder provided on the cam just above the spring, whereby upward movement of the spring is prevented.

511,245. THERMO-ELECTRIC ELEMENT; M. Mestern, Turin, Application filed May 4, 1891. In a relay with a circuit-closing armature acted upon by the magnet of the relay, the combination of the attracting magnet having a small self-induction, with the retarding coils having relatively large self-induction, so as to increase the attractive force of the attracting magnet at the beginning of signals and to hasten the reversal of polarity of the attracting magnet, at the end of the signals.

511,245. THERMO-ELECTRIC ELEMENT; M. Mestern, Turin. Italy. Application filed April 9, 1889. The combination of a block of iron in contact with a block or surface of an alloy of zinc and antimony and a body of nickeline or nickel compound entering into the alloy of antimony and zinc, and forming a conductor conveying the electricity generated.

511,254. CLOSED CONDUIT ELECTRIC RAILWAY; W. S. Smith, Berkeley, Cal. Application filed Feb. 29, 1892. In a system of electrical distribution, a sectional conductor connected together



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by junction boxes, the ends of the conductor provided with balls which fit in the sockets in the walls of the sockets consisting of two half-round blocks of insulating material held together by a clamping nut. (See illustration.)

511,259. RHEOSTAT; F. A. Weller, Boston, Mass. Application filed April 20, 1892. This consists of the combination with a series of radial supports, of the resistance conductor formed into close coils and held in place by clamping the supports between the coils, contacts and leads for connecting the resistance conductor therewith.

511,276. TWO-STATION TELEPHONE CIRCUIT; F. A. Pickernell, Newark, N. J. Application filed Aug. 7, 1893. The combination of a central station and two sub-stations with a metallic circuit extending from the central station and entering and terminating at the sub-stations by separate normally open metallic branches, there being interposed in each of the conductors of each branch a condenser of small capacity; each of the branches being provided in their relatively opposite conductors with an electric generator in a normally open grounded circuit and a high resistance call bell in a grounded circuit.

511,286. RESISTANCE BOX; A. O. Benecke, Newark, N. J. Application filed Sept. 10, 1892. The combination in a set of resistance coils or bridges of a series of fixed contact plates, a series of resistances respectively interposed between successive contact plates, and circuit connections and means whereby one or more of the intermediate contact plates may be electrically connected with either of the end plates of the series.